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CLIMATOLOGY

OF

NEW JERSEY.

BY

JOHN C. SMOCK.

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INTRODUCTION.

Climate has been defined to be the sum total of the meteorological phenomena which characterize the average condition of the atmosphere on any part of the earth's surface. What we call the weather is a single phase in the succession of phenomena, and hence climate may be said to consist of the weather changes which are observed from year to year in any given period of time.* The chief elements or factors of climate are temperature, humidity, rainfall, winds and pressure of the atmosphere. It is the province of climatology to exhibit the different phases of these meteorological phenomena, and to ascertain the causes of these differences. Practically, all of them may be traced either directly or indirectly to the sun, as the source of energy and activity, and hence the origin of what are termed solar climates. But the variations in all the climatic elements on the same parallels of latitude point to disturbing or modifying forces or conditions. The principal factors in thus modifying the phenomena of climate are four, viz.: 1. Proximity and relation to water areas; 2. Prevailing winds; 3. Height above the ocean; 4. Shape and nature of the earth's surface and its covering.

In general, there are two types of climate, the continental and the oceanic or insular. On account of the varied surface, with its interlocking forms of land and water, there are many gradations from the one type to the other, and no sharp lines of demarcation are possible, or classification of all the kinds of climate, which result, in part, from these relations of sea and land. The climate of New Jersey partakes of the continental type, and is marked by extreme features, but softened in some degree by the nearness to the ocean. Omitting the consideration of the factors of climate and their modifications due to

* Hand-book of Climatology, by Dr. Julius Hann, page 1, Stuttgart, 1883.

varying conditions, in so far as these refer to the earth's surface in general, the climate of New Jersey is here discussed under the following heads, viz.:

I. Temperature.
II. Winds.
III. Weight or Pressure of the Atmosphere.
IV. Atmospheric Precipitation.
V. Sanitary Relations.
VI. Permanency of Climate.

TEMPERATURE.

The situation of New Jersey on the Atlantic slope of the continent, between the ocean and the higher ranges of the Appalachian chain, gives it a climate of continental type, greatly modified by its proximity to the ocean, and by its configuration of surface. The constant play of these disturbing elements in the climate produce variety within comparatively narrow limits. And the State, although small, exhibits diversities, which correspond somewhat with its varied surface features. The elevation of the northern part, and the nearness of the southern portion to the sea, tend to heighten the influence due to difference of latitude only. The nature of the soil and the forests of the southern interior counteract the effect due to proximity to the ocean, and still further modify the climate in that part of the State. To properly estimate the influence of these factors is the difficult problem of the student of climatology. The meteorological statistics of places within and near the borders of the State are too incomplete, and, in some cases, faulty, to exhibit the results of their inter-action at every locality, or even in the well-marked natural divisions of the State.

Following the divisions of the older geographers, there are: the alluvial and *southern;* the secondary, hilly and *middle;* and the mountainous and *northern.* A more natural and correct subdivision, based upon the geological and topographic features, would be: 1. Kittatinny Valley; 2. Highlands; 3. Red Sandstone Plain; 4. Southern Interior; 5. Atlantic Coast, or Seashore Belt. Inasmuch as the data are too scanty to separate the first and second, there remain four divisions, or natural climatic provinces:

I. Highlands and Kittatinny Valley.
II. Red Sandstone Plain.
III. Southern Interior.
IV. Seashore, or Atlantic Coast Belt.

A further subdivision will follow the accumulation of records of careful observations at many stations, and the true climatic provinces of the State will be made out. It will be understood at the outset that while these divisions have definite characteristics, it is not possible to define sharply their boundary lines, or to indicate where the one ceases and the other begins, since they shade by insensible graduations into one another.

For the location and limits of these divisions reference must be had to the geological maps of the State.

Their boundaries, extent, elevation and general surface features, which modify the general character of our climate, together with local peculiarities induced by their varying intensity, are described under their respective heads.

Table of Mean Temperature for the several Climatic Divisions of the State. Degrees—Fahrenheit.

DIVISIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
I. Kittatinny Valley and Highlands	25.5	27.1	34.6	46.6	56.5	65.1	69.6	67.5	60.2	48.8	39.0	29.1
II. Red Sandstone Plain	28.5	29.9	36.8	48.5	59.6	68.8	74.1	71.3	63.9	52.5	41.6	31.3
III. Southern Interior	30.8	32.7	39.1	50.2	61.5	71.3	76.1	73.2	66.1	54.5	42.9	33.5
IV. Atlantic Coast Belt	32.2	33.3	38.0	46.7	57.5	67.1	73.1	72.2	67.2	57.1	45.1	36.2

	Year.	SEASONS.				MARCH OF THE SEASONS.			
		Spring.	Summer.	Autumn.	Winter.	Winter to Spring.	Spring to Summer.	Summer to Autumn.	Autumn to Winter.
I. Kittatinny Valley and Highlands	47.4	45.9	67.4	49.3	27.2	18.7	21.5	-18.1	-22.1
II. Red Sandstone Plain	50.6	48.3	71.4	52.7	29.9	18.4	23.1	-18.7	-22.8
III. Southern Interior	52.6	50.3	73.5	54.5	32.3	18.0	23.2	-19.0	-22.2
IV. Atlantic Coast Belt	52.1	47.4	70.8	56.5	33.9	13.5	23.4	-14.3	-22.6

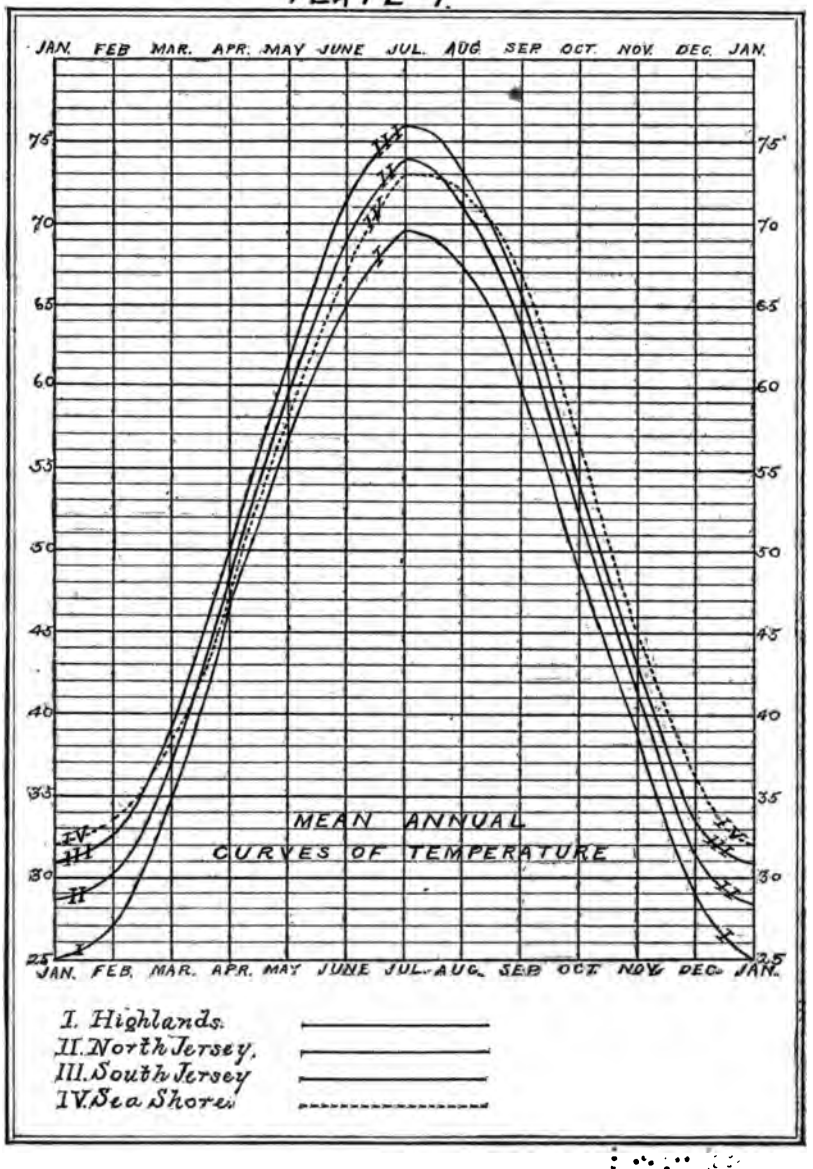
Introductory to these descriptions of the several provinces, and in order to convenience of reference, we give at the outset a table of mean temperatures for each month, season, and the year, in each of these four divisions of the State. They are obtained by taking the averages of the stations which are selected as representative of them. Thus, that of the first is the average of the mean daily temperature by months, as recorded at Goshen and Port Jervis, in Orange county, N. Y., and Dover, Morris county. The same method is used to get that for the seasons and the year. The figures of the table give the degrees and tenths, according to the Fahrenheit scale.

This table exhibits the gradual increase in the mean temperature of the months, of the seasons, and of the year, as we go from north towards the south, or from the Atlantic coast west-southwest. This difference between the Kittatinny valley and the southern interior amounts to nearly one month in the early spring, *i. e.* the temperature of February in the latter is nearly as high as that of March in the former. The differences of the seasons in the several provinces are not so great as in individual months. In general, it may be said that there is a difference of nearly one month in the spring, and a half month in the late autumn or at the beginning of the winter. The mean annual temperature ranges from 47°.41 in the north to 52°.6 at the southwest, a difference of about 5°, corresponding to 3° of latitude, or slightly more than the difference between the extreme north and south ends of the State.* New Jersey stands at the eastern end and near the south limit of the populous belt of our country, lying between the annual means of 45° and 55° of heat, and comprising the New England States, the Middle Atlantic States and the northern half of the great Mississippi valley.

A graphical representation of the table is given in Plate 1. The figures at the side express the mean temperature in degrees. These are connected by horizontal lines. The months are represented by vertical lines. The several divisions are represented by curved lines, and where these latter cross the monthly lines we have the temperature for months. The curves show the rapid increase of heat in the spring, particularly in April and May, in all parts of the State. The more gradual rise to the July maximum, and the varying rate of decline to August, are plainly shown. October and November bring

*The latitude of Carpenter's Point is 41° 21′ 22.63″. That of Cape May lighthouse is 38° 55′ 50″, a difference of 2° 25′ 32″, equivalent to 167.4 miles.

PLATE I.


JAN. FEB MAR. APR. MAY JUNE JUL. AUG SEP OCT. NOV. DEC. JAN.
75
70
65
60
55
50
45
40
35
30
25
MEAN ANNUAL
CURVES OF TEMPERATURE
I. Highlands.
II. North Jersey.
III. South Jersey
IV. Sea Shore.

the curves nearer together, as the heat decreases. The greatest divergence appears in the winter months.

The difference in mean temperature in the spring months has a marked effect upon vegetation, and the flowering of fruit trees is about three weeks earlier in the extreme southern part of the State than on the Highlands. The small fruits also come earlier, and are marketed before the picking begins in the central and northern counties. Early vegetables are produced in the southern part of the State as early as in Virginia. Melons, sweet potatoes and other semi-tropical products, which thrive so well in the central and southern counties, are scarcely attempted in the extreme north. There appears to be a difference of a week or so between Lambertville and the immediate Delaware River valley, and places in the interior and eastern side of the State, on the same parallels of latitude, in the earlier blossoming of certain plants and fruit trees.* But further observations are needed to indicate the extent of these differences of locality within our borders. The floras of the northern and southern counties differ widely, but how much is due to the nature of the soil and to proximity to the ocean water, and what is strictly owing to differences in heat, cannot be determined as yet with accuracy.

Following the isothermal lines of our State westward they diverge widely. The lines for the summers on our coast correspond with those for Northern and Central New York, and the region of the Great Lakes, while those of the southern interior correspond with the valley of the Ohio and Southern Missouri. The isocheimal or winter lines of the coast and of the southern end of the State also bend southward, and follow the same general direction as the isotherals, or lines of equal heat, for the summer. They show a milder climate than that of the same belt of latitude west of the State, and beyond the Appalachians. This ameliorating influence is due to the proximity to the ocean; and the same cause acts in summer to lessen the heat, particularly on the seashore.

* According to 13 years' observations at Perth Amboy (1819-1831), the mean date of blossoming of peach was April 21st, and of apple May 2d. Thirteen years observed at Lambertville (1840-1855), gave the mean dates of April 14th for peach, and April 26th for apple.—*Blodgett's Climatology, p.* 507.

Observations for same years (1844-1857, inclusive,) at both places show similar differences of 0 to 15 days in blossoming of peach, cherry and apple.

I. HIGHLANDS AND KITTATINNY VALLEY.

This division of the State is peculiarly the mountainous one, and outside of it, to the south, there are no elevations of 900 feet above tide-level. It includes the Kittatinny or Blue mountain on the northwest, which rises to a maximum height of 1,800 feet near the New York State line. It comprises the Highland ridges and the included valleys. And, in short, it may be said to be that part of the great Appalachian chain which is comprised between New York and Pennsylvania, within the bounds of New Jersey. The Ringwood, Rockaway and Longwood valleys, the Succasunna plains, German valley, Musconetcong, Pohatcong and Pequest valleys are the principal depressions in the Highland plateau or table-land. Their general trend is northeast and southwest, conformable to that of the ridges. The crests of the mountains are from 300 to 600 feet above the valleys, and are remarkable for their uniform elevation. And the average height above the ocean is 900 to 1,200 feet on the southeast, and 1,000 to 1,400 feet on the northwest. Budd's lake, Lake Hopatcong and Wawayanda lake lie in rather shallow depressions in it. The whole district may be viewed as a table-land from 900 to 1,500 feet high.

The Kittatinny valley is a section of the great valley which, from Canada to Alabama, is known as a continuous valley, under various local names. It lies between the Highlands on the southeast and the Kittatinny mountain on the northwest. At the Wallkill, on the New York line, its height is only 383 feet; at Belvidere, on the Delaware river, it is only 235 feet above tide, but in some of the slate ridges it attains a height of about 1,000 feet.

The surface of the Highlands at the southwest, in Hunterdon and in parts of Warren and of Morris counties, is marked by its smooth and uniform slopes, and it is largely in farms and under cultivation, whereas to the northeast, in Sussex and in Passaic, and, in general, north of the line of the terminal moraine, the glacial effect has been such as to leave it much more uneven and rocky, and consequently unsuitable for easy cultivation. And probably 75 per cent. of its area there is still in forest. The drainage of that portion lying to the south of the drift line is rapid, and there are no large tracts of wet or swampy lands as are found north of it. For a description of the marked differences of surface features between these sections of

the Highlands, the reader is referred to the last annual report of the Geological Survey.

In the Kittatinny valley the surface is very generally cultivated, and three-fourths of the area is cleared and in farms.

The Kittatinny, or Blue mountain, remains an almost unbroken forest belt.

These diversities of surface, the differences in height above the ocean, the configuration or shape and the trend of the valleys and ridges, all tend to produce differences of climate, although so small as scarcely to be detected among our few and short series of observations. As stated in the introduction, other things being equal, the mean temperature decreases about 1° for every 300 feet of increase in height. Applying this rule, we should expect to find that of the Highlands about 2° below that of the Kittatinny and other valleys, which are included among the Highlands. And at the same rate of decrease the crest of the Kittatinny mountain would have a mean temperature of 3° or 4° below the valleys on either side. That it is more exposed to the wind and sensibly cooler, is well known and observed by the visitors to the Delaware Water Gap and to High Point.* But the range is so narrow that the warm currents of the day cannot be cooled very much in their rapid passage up its comparatively short slopes and over its crest. The westerly winds coming from off the more wooded and mountainous country to the north and west are probably less heated than the same currents are after their passage across the Kittatinny valley. The differences are no doubt greater, *as felt*, than instruments would record. The earlier snowfalls on the Blue mountain at the beginning of winter show that the average temperature is lower. And the snow-covered crest is a common phenomenon to the inhabitants of the valley when that is yet bare.

The valley of the Delaware, from Port Jervis to the Water Gap, experiences high summer temperatures, although we have no records excepting that of Port Jervis, N. Y., at the extreme northern end of the State. Its average monthly temperature for the summer months is as low as that of Goshen, N. Y., which is in the Kittatinny valley and on nearly the same parallel of latitude. It corresponds closely

* The same range, as it continues in New York State, and is known as Shawangunk mountain, is found to be somewhat cooler than the valley on the south. Observations at the noted summer resorts of Lakes Mohonk and Minnewaski, in Ulster county, show it.

with that of Dover, in Morris county. The winter appears to be 2° to 3° colder than at the latter place. Compared with Easton, Pa., and Phillipsburg, on the Delaware, the winter is colder and the summer months also. This valley is much visited in summer and autumn by tourists who seek comfort, pleasure and health in its attractive localities. The beautiful and wild scenery, and the fishing and hunting, for all of which it is noted, divert the attention so that the extremes which are sometimes reported are not felt seriously. The greater coolness of the nights, especially in the summer, as compared with that of our cities near the sea-board, enable one to endure the same extremes by day with much more comfort. As compared with Newark, the Port Jervis record shows that the winter is 4° to 5° colder in the monthly averages, while the summer is 3° to 4° cooler. The extreme range of temperature is greater, reaching 8° to 10°, due mainly to the lower minima in the winter.

No meteorological observations are known to have been kept on the Kittatinny or Blue mountain, excepting at the U. S. C. S. station, at Culver's Gap, in Sussex county, where tri-daily observations on temperature were made from August 19th to September 29th, 1881, by A. A. Titsworth, M.S. In that time a maximum of 102° was reached (the thermometer hanging in the shade in the open air) on the 7th of September. The minimum and the daily means differ but little from those recorded by Mr. Whitehead, at Newark. But no conclusions about mean temperature can be drawn from this record. The night and morning hours in still weather on this crest would probably give higher readings than the valleys on each side, in consequence of the colder and denser strata of air settling in these valleys, leaving the warmer air about the mountain tops.

In the Kittatinny valley and the Highlands we have records at the following localities:

Deckertown, Sussex county	7 months.
Newton, Sussex county	8 months.
Dodge Mine, Morris county	1 year, 6 months.
Dover, Morris county	5 years, 4 months.
Mount Olive, Morris county	4 months.
Phillipsburg, Warren county	5 years (in part).

The periods covered by these records are so short that it has seemed necessary to add to them that of Goshen, Orange county, N. Y., which is 11 years in length, and that of Easton, Pa., 7 years long. Goshen

is 12 miles from the State line, but the valley there has the same general features as in Sussex county, and hence it seems fair to assume that it is representative of the northern part of *our* Kittatinny valley. Easton is at the extreme southwest, separated by the river only from our territory. It may stand for the lower or southwest parts of our Musconetcong and Pohatcong valleys, as well as the Kittatinny valley. These two stations may represent that part of the great Kittatinny valley, which is within the limits of the State. The Goshen record shows that the winter minima fall 5° to 30° below zero; and the summer maxima reach 96° above zero. The Easton records have the extreme range from 14½° below to 102° above zero. The mean temperatures at Dodge Mine and at Dover have been compared with the Newark record, for the same periods, and then reduced so as to give more fairly comparable averages for the Highlands. As compared with Goshen, N. Y., the observations at the Dodge Mine run nearly alike in the winter months; the differences in autumn and summer are small; the spring months are colder at the latter place. Possibly the later melting of the winter's snows in that wooded, mountain district, retards the advance of heat in the spring. The record at Dover shows an average monthly temperature of 2°.4 above that at the Dodge Mine. It appears to represent a Highland valley; and, with Easton, Pa., these valleys are fairly represented. It is noticeable that these two stations agree closely in the averages for the colder months; whereas, during the warmer part of the year, the mean monthly temperature at Easton varies from 2° to 4° above that of Dover. The records are too short to afford data for the extreme ranges of temperature; and, in order to get a longer series from the Highlands, that of West Point, on the Hudson river, and near tide-level, has been inserted in the tables of temperature. Its wide range agrees with that of Goshen, in the same county—our Kittatinny Valley station. As compared with Newark, the Highlands have an average monthly temperature 2° to 6° lower, being greatest in autumn.

In general, the climate of the Highlands is not marked by excessive extremes of temperature. The spring opens a few days later than it does in the valleys and on the Red Sandstone plain, but it advances rapidly, so that May is nearly as warm, and vegetation on the first of June is quite as forward, as on the lower lands.* The summer is not

*On Schooley's mountain the spring is five to eight days later than it is in the Musconetcong valley, and the wheat and rye harvests are nearly as much later.—*Wm. W. Marsh, of Schooley's Mountain.*

marked by so great extremes of heat, and hence the hot weather is much more endurable. The attractiveness of Schooley's mountain, Budd's lake, Lake Hopatcong, Newfoundland and Chester, is no doubt greatly owing to the absence of excessively high temperature in midsummer. But more marked are the lower night temperatures, and all travelers and tourists going from our cities into the Highlands notice the cooler and more refreshing nights, and thereby experience the relief which comes from such a delightful change. In the winter the lowest temperatures are but little below those observed in Newark and the central part of the State, although the average minimum may run uniformly lower than in the latter. It is said by observers of the weather that the extremely low winter temperatures on the hills are often several degrees above what is recorded at such times in the adjacent valleys. This striking phenomenon has been particularly observed on Schooley's mountain, which has the deep German and Musconetcong valleys on its sides. Such phenomena accord with what has been observed elsewhere in mountainous countries, and they harmonize with the explanation given on a preceding page in reference to the Kittatinny mountain. The frosts come later in autumn on the hills and ridges of the Highlands than they do in the valleys. But the low and wet, swampy depressions among the hills, especially north of the terminal moraine, are not thus favored. In some of the wet localities in Sussex county frosts have been known to occur in August. This exemption from frost is more marked to the southwest, in Hunterdon and Warren counties and the southern part of Morris county. Generally there are no frosts which injure vegetation much before October, and in some years none are severe before the first of November. The most remarkable and striking difference between the Highlands and the Red Sandstone plain, to the south and east of them, is the earlier appearance of snow in the late autumn or at the beginning of winter. The same storm bringing rain to the latter, covers the higher mountain ranges with snow. This first coming of snow is often a fortnight earlier; and the sleighing season begins earlier and continues later than it does in the central or eastern parts of the State. Even between Schooley's mountain and Hackettstown there is often all the difference between good sleighing and roads bare of snow. From New Brunswick a like difference between the red shales of the Raritan valley, and the snow-covered Chester and Fox hills ranges in the northwestern horizon, is often observed. As the

weather grows colder this distinctive mark is obliterated by the winter storms, which sweep over the whole country and envelope all alike in snow.

In the winter the cold is not sensibly greater than in the lowlands, although the minima recorded at Goshen and Easton and West Point run several degrees below those of Newark, New Brunswick and Trenton. And this is true in the face of much longer periods at the latter places, giving opportunity for lower extremes. The West Point series, so much longer, appears to confirm the occurrence of low winter temperatures in the valleys. The northeast and southwest courses of these valleys in a measure protect them and permit the free movement of warm, southwest currents of air through them, far into the Highlands. The northwest sides of the valleys are sheltered, as it were, by the steep hills and mountains to the west of them. The southern slopes are more nearly exposed to the perpendicular action of the sun's rays, and thereby more quickly warmed than those to the north. The greater depth of the snow in the spring, on the northerly mountain slopes, shows the less active melting influence of the sun on that side of the hills generally.

The well-drained surface of the more southern part of the Highlands, and the more porous and drier gneissic soils must have some influence upon the humidity and the temperature of the air, and upon the general healthfulness of the country. Then, again, the greater proportion of cultivated area, as compared with forest, makes the surface drier and so affects, indirectly, the climate. To the north of the terminal moraine line there is much more wet and swampy land and a much greater area covered by forest. These unite in making the air more damp, and their effect is, as has been stated in the introduction, to lower the temperature slightly.

It is unfortunate that we have so few meteorological stations in this part of the State, since it would be of great interest and of public importance to show by figures the differences which are here indicated by general statements only. And not only to demonstrate these positions, but to exhibit the features of climate, which make the Highlands so attractive for tourists and for rural homes and retreats, and so comfortable and health-giving to both the natives and also to the invalids who seek strength and health on these hills.

II. RED SANDSTONE PLAIN.

Under this head is placed the middle (or more properly, the north central) division of the State, and which is coincident with the limits of the new Red Sandstone formation. The larger part of Passaic, Somerset, Morris, Hunterdon, Mercer, Middlesex, Union, Essex, Hudson and Bergen counties are in it. And it has a breadth of 15 to 30 miles, and stretches south-southwest and west-southwest, to the Delaware river. As compared with the deeply-furrowed and mountainous Highlands on its northwest border, it seems as it were, a great plain. But its surface is diversified by gently-swelling ridges and by jagged and steeply-sloping trap-rock hills and mountains. They divide it into subordinate valleys. The Upper Passaic valley is one of them thus shut in by trap-rock ranges. In the central part of Hunterdon county, between the South Branch and the Delaware, there is an elevated district or kind of table-land. The Round valley, near White House, is a small but notable example of another of these valleys. At present it is impossible to show any differences in temperature, or climate, which these natural divisions suggest.

The general slope of the plain is southward, from the border of the Highlands, where the height is 300 to 400 feet, to tide-level on southeast and east.

The trap-rock ridges rise 200 to 500 feet above the adjacent Red Sandstone country, culminating in High mountain, at 879 feet, and in the Watchung mountains, at 691 feet. The Palisade mountain range is 300 to 522 feet high. These mountains are nearly all still in forest, whereas the plain has scarcely any forests left, excepting in Bergen and Morris counties. In the absence of comparative records, it is not possible to show what the differences in temperature are between the Palisades and the low-lying country on the west. The valley of the Upper Passaic also ought to have a slightly different range in temperature and rainfall, as well as in other climatic elements. No doubt there are differences, corresponding to what is known to exist between the Highlands and its included valleys. A difference is noticed in the frosts and in the early winter snows which whiten the hills, when the plain to the east is still bare. Certain it is that the residents of Madison, Caldwell and Orange mountain believe that their rural homes are more comfortable during the hot weather than residences in Newark or New York. But the more open situa-

tions in the country, which allow a free circulation of the air, are an advantage which may offset mere temperature. The measurement of the total air movement, or the winds, would show a great difference in favor of these hills. The greater percentage of area in forest on the trap-rock ridges also exerts an ameliorating effect in the warmer months. The hot, southerly winds, striking the mountain tops and passing over woodland whose soil is not parched and dried up by long-continued drought and heat, are sensibly cooled.

The country to the west and southwest of the Watchung mountain ranges, and which is drained by the Raritan, is a low-lying plain, almost bare of timber, and it is, consequently, exposed to both the full sweep of the winds, and to the heating effect of the sun's rays. It is subject to the extreme temperatures of the summer, whilst the greater part of it is too far from the ocean to enjoy its equalizing influences. The records of New Brunswick and Trenton give high summer temperatures, not exceeded by any other records in our table. The remarkably large area almost entirely destitute of forest, and the quick-drying shale and sandstone soils, allow of an accumulation of heat in them. And it seems as if there was some connection between the soil and the lateness of the frosts in autumn, which keep off longer than they do in the Highlands and the Kittatinny valley. The mean difference in temperature due to this bared condition of the country can amount to 1°.3, as mentioned above.

West of the South Branch and north of Flemington there is a table-land 500 to 800 feet high, and occupying an area of nearly 150 square miles. The Delaware flows along its southwest border, or, more properly, it may be said to flow through it, as the elevated country continues westward into Pennsylvania, and the river has eroded a deep cañon-like valley through it from above Milford to Lambertville. Such an average height must reduce the mean temperature at least 1°, as compared with Lambertville and Trenton, or other localities in the lower surrounding country. But we possess no meteorological records from it.

The Red Sandstone plain has a well-drained and naturally dry soil, excepting in the Upper Passaic valley, where there are extensive tracts of wet meadows and swamps, and some smaller areas of wet lands in Union county. These are all north of the terminal moraine line. There is also more forest, in proportion to the whole surface, in the country to the north of the same line than in the central or

western parts. The trap-rock soils are all cold, and generally wet, even when cleared and cultivated. The effect of these variations in the soil, though slight, cannot be wholly ignored. They are capable of measurement in the Upper Passaic valley, and on the Watchung mountains, if not elsewhere.

The varying distances from the ocean also have their influence. The records of Bloomfield, Newark and South Orange, when compared month by month with New Brunswick, Somerville and New Germantown, show the more even temperatures at the former, amounting to a little over 1° for the autumn and winter, whereas in the spring and summer the variation is reduced to a minimum.

These disturbing or modifying elements in the several parts of this province or division of the State are not so marked in their results that we can do more than indicate a probable further subdivision, according to the well-marked natural lines mentioned above.

For the list of stations, with their elevation and length of observing period, as also names of the observers, reference must be had to the folded table of temperature. The greater number of stations and their long series, as compared with the scanty records of the Highlands, are noteworthy. But this is the densely-populated belt of the State, and there are living on it 650,000 inhabitants, or more than half of the people of our State. Its climate affects the majority of our population, and hence the importance of records from so many localities.

The mean temperature, by months and seasons, at the several stations, together with the maximum and minimum for the months and year, are given in Table of Temperature. And the mean temperature for the five principal stations, which represent fairly this part of the State, is given in the first table on page 327. The annual mean temperature is 50°.6, or about the average for the whole State. The figures from the several station records vary from one another to the extent of 2° in the averages for the months. Thus, New Germantown, near the northwest border, has the lowest temperature of these stations of longer records. And the difference is mainly in the autumn and winter months. Readington, with a shorter record, is marked by higher temperature than New Brunswick, but a further and longer term of observing may show less contrast between these places. The closer correspondence between Somerville and New Brunswick, seems to indicate that the record for Reading-

ton is abnormally high in its averages for the months. Comparing Lambertville, on the Delaware river, with Newark, both of which are long series, the monthly and seasonal averages agree quite closely. The only notable difference is in the autumn, which, at Newark, is nearly 2° warmer than the same season at Lambertville. The correspondence throughout all the monthly averages for Newark and Paterson, is remarkable, especially in view of the wide margin in the rainfall comparison of these cities. The long records at Morrisville, Pennsylvania, opposite Trenton, and at Fallsington, in Bucks county, also in Pennsylvania, are inserted in the long table on temperature. And they may be taken to represent the southwestern end of this division better than the Trenton observations. They indicate about a degree warmer average winter temperature than that of New Brunswick. And the more luxuriant growth of the common ivy at Trenton than at the latter city also proves a milder winter. The range of temperature for the year at these stations near the Delaware and at New Brunswick, is slightly greater than it is at Newark or at points on the waters of New York and Raritan bays.

The climate of this belt, so far as temperature is concerned, approaches nearest to what may be considered an average of the State. There is greater uniformity of surface than in that of the Highlands, and there is less forest in proportion to the whole area, than in any other division of the State. The range of temperature for the year is, however, larger than in the other climatic provinces, stretching from 22° below zero to 103° above, or 125° for the year. These figures are the results derived from long series of observations stretching over half a century, whilst in the other parts of the State we are confined to much shorter periods. The monthly variations also are wide, and ranges of 70° in a given month have been recorded. March generally affords the greatest extremes, owing to sudden warm periods of short duration, when the thermometer reaches an unusually high maximum. The winter months also have wide ranges, due to extremes in both directions from the mean temperature. While there are these high monthly ranges, the climate is not excessive. The winters are less severe than they are in the Highlands, and are not quite so long. And occasionally they are very mild, and the ground is unfrozen and the streams are free from ice, even in midwinter. The cold weather usually comes about the holidays, and is accompanied with the formation of thick ice and snow. A common phe-

nomenon is the "January thaw," which may be termed a period of a week or ten days of mild weather, when the frost disappears almost entirely from the ground and ice breaks up in the streams, giving rise to freshets. The examination of long-continued observations has so far failed to detect any regularity in the occurrence of such a warm spell. All that can be said of it is that it is not uncommon.

The coldest weather occurs most generally in January and the middle of the month, but to this rule there are many exceptions.

In the winter of 1880–1881 the cold day was the last of December. The winter may be said to continue until the middle of March. The advance of the spring is generally slow until the latter part of April or first of May; but from that time onward it is rapid. Both the spring and autumn are shorter than our calendar seasons; and the more natural divisions of the year for all the central part of the State would be, winter until the vernal equinox, three and a half months; spring until June, two and a half months; summer until near the autumnal equinox, or to the middle of September, three and a half months; then autumn until first of December. The cold and hot seasons cover more than one-half of the year. A reference to the diagram, Plate 1, will illustrate this statement. The period free from frosts, or what may be termed the growing season, often continues quite into October, and sometimes to November. Frosts have been known earlier, as in such an exceptional year as that of 1816. But the three summer months are, practically, exempt from any frost.

The winter usually begins about the first of December, when the ground begins to freeze and ice is formed. In November there is a variable period of warm and smoky weather, which is known as "Indian Summer," apparently due to smoke from forest fires in the more wooded districts to the north and northwest. The subject of its occurrence has been studied elsewhere, and at Toronto, in Canada, a long series of observations appears to show that its occurrence is limited to the period of October 5th to November 23d, generally coming October 27th to November 2d, and lasting six and a half days. Here in this belt, as in the northern and also in the southern interior belts or provinces, the so-called "Indian Summer" is always anticipated, although the cold preceding it may have the semblance of early winter. Snow sufficient for sleighing, for a short period at least, occurs every winter. In this particular the belt marks a transition from the Highlands, where *sleighing snows* mark every winter, to the

southern interior, where there may pass a winter without sleighing. That of 1879 and '80 was remarkable for its slight depth of snow, and its generally warm weather. Reference to the historical notes and to chronological notes of the weather on succeeding pages will afford examples.

III. SOUTHERN INTERIOR.

In the northern half of the State the geological structure is the basis for our climatic divisions. In the southern part the nearness to the waters of the ocean on the east, and to the Delaware bay on the west and southwest, exerts a modifying influence; the elevations above ocean level are comparatively so inconsiderable that they may be disregarded altogether. The nature of the surface and the character and extent of the forest disturb but slightly the climate, as determined by latitude, by proximity to the sea and by prevailing winds.

Under this head all of the southern part of the State is included, except the narrow belt bordering the ocean and a part of Cape May, which make the fourth climatic province of this description. The limits on the north cannot be indicated or traced except in an approximate way. But the line may be said to follow the Raritan bay and river and then Lawrence's brook, and thence a southwest course to the Delaware near Trenton. Of course, it is understood that all of these divisions merge gradually into one another, and that no sharp lines of demarcation are possible.

The southern part of the State has an average height of 200 feet along the divide between the Atlantic ocean and the Delaware river. The surface slopes gently each way to these waters and to the Delaware bay at the southwest. There are no rocky outcrops nor any steep slopes, as in the northern part of the State. The surface is gently-rolling to hilly, and the elevations have no measurable effect upon the temperature, so far as our records show. In regard to the nature of the soil, it is in general comparatively sandy. And the pine-land belts have broad expanses of glistening white sand surface, on which there is a very scanty growth of pitch-pine (*P. rigida*), and scattering, scrubby oaks. They are parts of the so-called "pine barrens" of older writers. The general influence of soil and forests has been mentioned in the introduction and referred to in the descriptions of the Highlands and of the Red Sandstone plain. In this

province their influence is more marked than to the northward, on account of their striking peculiarities. And it is most evident in the temperature of localities. The conductive power of such soils and land surfaces is such that they become intensely heated by the sun's rays falling directly upon them, both more rapidly and to a greater depth than more clayey and grass-covered soils. In short, they are *warm soils.* They often become so hot in the heat of the day as to be almost unbearable to the touch of the bare foot or hand. The stratum of air in contact with so hot a surface is also heated, and in this way the lower atmosphere is raised to a higher temperature than it would be over a cold, wet soil, or over water. The influence of such a sandy soil is both heating and drying, and somewhat like that of a desert, making the days hot and the nights, owing to rapid radiation of the heat, cool, and producing a wide daily range. Hence, also, the occurrence of frosts late in the spring and early in the autumn also. The heat of the day forces vegetation forward early in the spring and then the cold of the night may bring frost to kill it.* While the influence of so sandy a surface is greatest in the pine-land belts, it is felt throughout this whole division to some extent. The observations at Atco and Vineland show something of the extremes of temperature, although the averages of the daily range would be more expressive of their extent. As it is, the range of temperature during the year varies from 98° to 116° at given localities, or to 121° for the whole of South Jersey. And a range of 84° within a month's time has occurred.

The mean temperature also runs high in the summer, particularly at Atco and Vineland. That of the winter is not correspondingly so much higher than like months or seasons in the northern part of the State.

The climate of this large division varies a little from north to south, being warmer at the southwest, and also from east to west, but these variations are confined within narrow limits. The observations at Freehold show in general a lower temperature for all the months than that of any of the other stations. It is possible that the difference is that corresponding to that of latitude alone. Along the Delaware river from Bordentown down, there is a very narrow

* A remarkable instance of late frost occurred in the beginning of summer, June 6th, 1878, which was felt in Ocean and Burlington counties severely. The tender oak leaves were killed and fell off and were succeeded by a second growth, giving to the forests a strangely unseasonable appearance.

strip of country which is influenced by the proximity of the river. The prevailing west and southwest winds, as they sweep across it, are no doubt slightly cooled by it, in the summer and autumn months, while later in the season the presence of such a body of water tends to raise the temperature. On account of its soil it is noted for its adaptation to the production of early vegetables and small fruits. And truck farmers say that within a short distance of the river the frosts are not so late in spring, and *keep off* later in the autumn than they do further from it. In general, the climate differs little from that of the Red Sandstone plain, described above. The seasons are all from one to three degrees warmer, with the greater difference in the winter, owing to the equalizing effect of the greater nearness to the ocean. There is less snow, on the average, and the ground is bared sooner by the more rapid melting. The winter of 1880–81 was, however, an exception, and the snowfall in Monmouth county was nearly twice the depth of that in the northern part of the State. For the details of localities the reader is referred to the table on temperature, which gives the mean maximum and minimum temperatures, monthly at the stations.

The following tables, from the records of Thomas J. Beans, at Moorestown, in Burlington county, and of Dr. John Ingram, at Vineland, in Cumberland county, showing the late and early frost dates and the periods between frosts, are here inserted as bearing upon these important phenomena of climate. The observations at Moorestown are from 1865 to 1887, inclusive; those of Dr. Ingram extend over fifteen years—from 1866 to end of 1880. They fairly represent the southern interior. The average length of the season at Moorestown is 179.6 days, or about six months. The Vineland table shows the severity of the winter also. And both indicate June, July, August and September as the warmer months, free from all frosts.

Table of Frosts.

By THOMAS J. BEANS, Observer, Moorestown, N. J.

YEAR.	FROSTS INJURING TENDER VEGETATION.		Length of Season.
	Latest in Spring.	Earliest in Autumn.	
	Date.	Date.	Days.
1865	April 14	October 14	186
1866	May 15	October 5	143
1867	May 14	October 25	174
1868	April 24	October 17	176
1869	April 15	October 21	189
1870	April 20	November 8	202
1871	April 18	October 21	186
1872	April 23	October 29	189
1873	April 13	October 26	196
1874	April 30	October 15	168
1875	April 25	October 13	171
1876	April 26	October 12	169
1877	April 15	November 4	203
1878	April 17	October 22	188
1879	May 10	October 29	164
1880	May 1	October 19	170
1881	April 27	October 6	162
1882	May 3	November 3	184
1883	April 30	October 17	180
1884	April 22	October 26	188
1885	May 12	October 23	164
1886	April 9	October 17	191
1887	April 21	October 16	178
Range	April 9	October 5	203
	May 15	November 8	143
Average length of season			179.6

Table of Frosts.

By Dr. J. Ingram, Observer, Vineland, N. J.

YEAR.	JAN.		FEB.		MAR.		APR.		OCT.		NOV.		DEC.		YEAR.	
	Days.		Days.		Days.		Days.		Days.		Days.		Days.			
	Some Frost.	All Frost.	Some Frost.	All Frost.	Some Frost.	All Frost.	Some Frost.	All Frost.	Some Frost.	All Frost.	Some Frost.	All Frost.	Some Frost.	All Frost.	Some Frost.	All Frost.
1866	21	5	20	4	15	...	3	...	1	...	10	...	23	13	93	22
1867	29	22	10	2	14	3	...	...	3	...	9	...	26	11	91	38
1868	26	13	28	17	14	4	5	...	4	...	10	...	26	11	113	45
1869	22	4	17	4	19	5	...	...	5	...	16	...	22	3	101	16
1870	12	2	23	4	16	3	...	...	1	...	7	...	18	7	77	16
1871	23	12	18	5	4	...	...	...	1	...	12	3	20	10	78	30
1872	24	11	25	5	22	5	...	...	2	...	13	2	27	12	113	35
1873	23	8	22	10	15	...	...	...	2	...	16	...	14	1	92	19
1874	16	6	21	8	13	1	4	...	2	...	15	1	21	3	92	19
1875	28	15	23	15	17	3	2	...	1	...	13	1	15	5	99	39
1876	17	5	16	5	17	2	1	...	3	...	7	...	30	17	91	29
1877	27	11	17	2	13	4	1	...	1	...	7	1	14	...	80	18
1878	21	10	17	3	5	...	...	...	1	...	8	...	23	11	75	24
1879	26	10	25	7	15	...	...	...	2	...	12	1	12	3	92	21
1880	12	...	17	3	12	...	5	...	6	...	21	7	27	16	100	26
Range	29	22	28	17	22	5	5	...	6	...	21	7	30	17	113	35
	12	5	10	2	4	0	0	...	1	...	7	0	12	0	75	16
Means	22	9	20	6	14	2	1.4	...	2	...	12	1	21	8	92	26

Note.—"Some Frost" means any degree of frost, and includes whole frosty period, recorded by days. "All Frost" indicates days when temperature throughout is below 32°, or freezing.

At the southwest, bordering the Delaware bay and the lower part of the Delaware river, there is a belt of low, alluvial necks and tidal meadows, whose proximity to these waters and whose more *clayey*, cultivated soil, mark it as almost a subdivision or subordinate part of this climatic province. In the absence of long records at well-located stations of observation, it is not possible to define the limits of this belt, or to prove the existence of any marked peculiarities in climate.

The results of a comparison of Greenwich and Newark for a like period are: 2°.7 warmer, spring; 2° warmer, summer; 2°.5 warmer, autumn, and 4° warmer, winter season. And in comparison with other places in South Jersey, the records show that at Greenwich the winter is from 1° to 2° warmer. Compared with Atlantic City, which is on the same parallel of latitude, Greenwich for the year is 2° warmer; the winter temperatures practically agree, both being made more even by the presence of bodies of water near them, but the summer at Greenwich is 5° warmer than at the seaside. As already remarked, there is about a month's difference between this part of the State and the extreme north end in the spring, and nearly as much in the autumn, making the season nearly two months longer.* The winter is not only mild, but is not accompanied by much snow. The account given in De Vries' Journal, in 1631, is true of some of the winters of the present time.†

IV. ATLANTIC COAST, OR SEASHORE BELT.

That part of the State which borders the ocean, and is near enough to be more directly exposed to the ameliorating influence of its waters, is here designated as the Atlantic Coast Belt. It is difficult to define its limits, as it merges into that of the southern interior on the west and northwest. The influence of the ocean's waters is felt very decidedly to a distance of four to eight miles from the line of beach or outer coast line, from Sandy Hook to Cape May. In Monmouth county it is thought to be four or five miles; in Ocean county it follows closely the line of clearings or settlements, not going beyond the

*The spring at Greenwich is about two weeks earlier, as shown in blossoming of the peach, the cherry and the apple, than it is at Perth Amboy, and 10 days in advance of Trenton.

†See Chronological Notes of Weather at end of this paper—year 1631.

line of woods or into the forest belt. It is here from four to seven miles wide. In Burlington, Atlantic and Cape May the breadth is five to eight miles. Open bays and tide-marshes, as along the Little Egg Harbor river and Great Egg Harbor, allow the winds of the ocean and the tidal waters to carry these influences further inland. In severe storms the salt spray is felt for several miles back from the shore.* The effect of the prevailing sea winds is not, however, noticed far from the shore in the pine districts. But the isolated and scattered trees of fields, and the woods on the beaches, all show it in their westerly and unsymmetrical growths. The western limit of the summer sea breezes is variable, depending on the season. They may be said to prevail during the summer season over a belt four to five miles wide. But in very dry seasons, and in the spring sometimes, the peculiarly moist and refreshing sea air is noticeable ten to twenty miles back from the water, and occasionally the sea wind sweeps across the State.† But its arrival at these more distant points is at a later hour in the day; and it is not a daily, but an exceptional phenomenon.

The records of observations by the United States Signal Office at Sandy Hook, Barnegat, Atlantic City and Cape May, with those of voluntary observers at Middletown, Long Branch, Squan Beach, Oceanic, Toms River, Peck's Beach and Ocean City, are the data for this seashore belt. And the mean seasonal temperatures, as derived from the longer series, are:

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* According to statement of Eli Collins, of Barnegat, a *dry storm*, September 3d, 1821, carried spray of salt water three miles inland, upsetting stacks, &c. It lasted from 9 A. M. to 3 P. M. For two hours it was cloudy and dark—a hurricane. It killed the leaves of the trees, and after they fell new buds and flowers were developed the same year. Trees were not, however, killed.—[*From notes taken by Prof. Cook, in 1856.*]

The same gale was felt with great violence on the Long Island coast, and in a recent published account of it, Col. B. Aycrigg, of Passaic, who was staying at Jerusalem, on the south side, says: "Its violence may be estimated from the fact that where I was staying, at two miles from the bay and six miles from the sea, the salt water was blown against the windows and left a crust of salt, which had the effect of ground glass, and the leaves on the southeast sides of the trees were killed, turned brown and dropped off."

† Mr. Thomas J. Beans, of Moorestown, Burlington county, writes: "Our house is on a gentle eminence, and in hot, close and quiet summer days I have been observing frequently that at about 4 P. M. a refreshing breeze from the southeast springs up and continues steadily until evening, producing a sensation so unlike that caused by winds from other quarters that I often find myself wondering if, under favoring conditions, our sea breezes almost cross the State."—*Letter to Dr. Cook, April 10th, 1888.*

Spring	47°.4
Summer	70°.8
Autumn	56°.5
Winter	33°.9
Year	52°.1

These figures show the milder winter, the warmer autumn and the cooler spring and summer than are observed in the same latitude in the southern interior or even the Red Sandstone plain. The diagram (Plate 1) exhibits these contrasts more clearly than the figures of the table. As compared with interior stations, the difference appears to reach the maximum in July. The highest temperature is usually in August, and the decline is then slower than at places further inland. The observations at Sandy Hook, Barnegat and Atlantic City agree closely in the average monthly temperatures, through the autumn and in the winter. Sandy Hook is colder, as would be expected, but after March its average is 1° to 2° warmer through the summer. The annual mean temperature is 52°.1, or a little less than that of the interior of South Jersey. The comparison between the seashore and the inland is well exhibited graphically by the curves in Plate 1. At the former, the mean temperature for the months from March to August, inclusive, is from 1° to 4° lower; whereas, from September to February, inclusive, it ranges from half a degree to two and a half degrees higher than at the interior stations. The equalizing effect of the water is thus seen in the more even temperature. The extremes of the year as brought out in these longer periods of observation, are 99° above and 10° below zero, or 109° as against 121° for the like range of the southern interior. The winds from the sea are warmer in winter and cooler in summer, than those blowing off shore. The sea breezes of the hot season spring up generally about noon, so that the maximum for the day is before noon, or at noon, just before the incoming of the cool, sea air. The influence of these sea winds is to temper the extreme heat, to reduce both the range and the mean temperature in the warmer months, and to give a more humid character to the air. During the cold weather the storms which bring snow in the interior are accompanied by rain along the coast. The snow disappears more quickly at these localities. Sleighing is possible for very brief periods only. At Atlantic City it is unknown some winters. These sea beaches, situated as they are, with the ocean on one side and the tidal waters on the other, have a climate partaking

slightly of the insular type. Barnegat station is separated from the mainland by the Barnegat bay, which is four miles wide. Atlantic City is at least five miles in a direct line from the nearest mainland. But the maximum and minimum temperatures at each of these places show that the range in the year may be nearly as much as it is in the interior of the State. The average daily variation is less. The average maximal and minimal curves also are unlike those representing places in the interior. Thus, comparing the temperatures day by day at Philadelphia and Atlantic City for 1886 and 1887, the following differences are notable: In the four colder months the highest daily readings differed on the average only 0°.5 to 3°. From April to June, inclusive, the average maximum at Atlantic City was from 6° to 12° lower than at Philadelphia, whereas for the same months the average minimum was only 1° to 4° lower. There are not such extremes of heat, and the average cold is little greater. For July to September, inclusive, the maximum is 2° to 6°, and the minimum 1° to 3° lower at Atlantic City. In October and November the differences are all less than 2°. The influence of the ocean appears to be to reduce or lower the maxima in the spring, summer and autumn more than it does the minima.

This moderating influence is, therefore, greater in summer than it is in the winter months. And what is true of Atlantic City applies generally to the seaside. The milder winter of our coast is, however, a well-known fact, although the records of observed winter temperatures, when thus compared, do not exhibit the differences which have been said to exist. That the Gulf Stream tends to raise the average temperature is evident from its nearness to our coast. The general influence of the Gulf Stream, as given by Chas. A. Schott, of the United States Coast Survey, in Smithsonian Contributions to Knowledge, No. 277, p. 105, may be thus summarized: "In the *winter* months the proximity of the Gulf Stream to the Atlantic sea-board has the effect of *elevating* the temperature in the vicinity of the ocean, the amount being 0° in Florida, about 4° in North Carolina, and about 8° or 10° in Massachusetts; in the summer months the effect is reversed, as shown by the isotherals curving southward; this is due to the cold current running southward, between the coast and the Gulf Stream, and the depression produced would be still greater, but for the circumstances of the prevalence of the *westerly* winds, which carry the heated air to seaward. The depressing effect, however, in amount, is

less than one-half that given for the opposite season." Of course this influence is not materially more ameliorating at one point than another, and it is a common factor in the climate of the whole coast belt. The delightfully warm weather of some of the late winter and early spring days, when the wind is from the southeast quarter, is due probably to the nearness of the Gulf Stream. On the contrary, the south winds, which blow over a long belt of the colder shore current, are chilling, especially on the beaches south of Barnegat.

There is a noteworthy difference in the winter season, between Cape May and the other coast stations. It is seen in the difference in the average daily minimum, which, at Barnegat and Atlantic City, is four to five degrees lower than it is at Cape May. The extreme temperatures at these places also run lower—from four to nine degrees. The more southern situation of Cape May has something to do with this higher average minimum of the winter. But the Delaware bay on the west explains a part of it. The winter winds from west and west-northwest points of the compass are tempered by the latter, and are not so cold as land winds generally. The position of Cape May is more *insular* than that of Atlantic City or Barnegat. The evenness of its temperature is quite remarkable for its latitude, and for our Middle Atlantic coast. In its slight daily range it compares favorably with more southern stations in our country. It is warmer in winter than Washington, and its mean daily range of temperature is four degrees less than that of Norfolk, Va. The Monthly Weather Review of the United States Signal Office, nearly every month, gives Cape May as having the least daily range of temperature among its Middle States stations. And the range is nearly as low as that of Cape Look-out, in North Carolina, and Key West, New Orleans and Galveston, in the Gulf States. The average, as there stated, for three years is, for Cape May, 19°; while that of Key West is 16°. These figures show that in the *daily* range of temperature Cape May compares favorably with our most southern localities. Of course the *monthly* range exceeds that of the more southern stations here mentioned. The changes are not generally sudden.

It is interesting here to observe that the isothermal line of 36°, the mean temperature, runs, according to the charts of the Smithsonian Institution, through West Virginia, North Carolina, Northern Georgia, Eastern Tennessee and Southern Missouri, near the parallels of 36° and 37° north latitude. The effect of so high a mean

temperature in the spring is to produce crops of vegetables and small fruits quite as early as Portsmouth and Norfolk, Virginia. And the season is generally about a month in advance of it in the northern part of the State. But in late springs the difference is not quite so much. The summer is warm enough and the season long enough to produce cotton. According to Blodgett's "Climatology of the United States," pp. 436–7, Huntsville, Alabama, represents one of the best cotton districts near the limit of its northern extension. Now, the mean temperature of Huntsville, in the winter, is, on the average, 7° higher than it is at Cape May, but the thermometer often falls to zero, and occasionally several degrees below zero, extremes unknown in Cape May. The following popular description of the climate of Cape May, by Dr. S. S. Marcy, appeared in the "Geology of the County of Cape May," Trenton, 1857, p. 89:

"Our winters embrace every variety of cold and temperate weather. Ice is rarely obtained in this neighborhood more than four inches thick, and frequently but three inches; often it is but a short time that it can be obtained of this thickness. It is cut from still water, in artificial ponds, which are only one or two feet deep. So great is the uncertainty of obtaining a supply of ice, that we commence filling our ice-houses with ice from two and a half to three inches thick; and every team within a distance of six miles is put in requisition for that purpose, with *retaining fee*, some weeks before the appearance of the ice.

"The lowest temperature observed here for the last 30 years was 2° above zero. This was on the 9th of January, 1856. On the 10th it was 4°; and for several days the thermometer was as low as 8° or 10°. This will long be remembered as the cold winter of 1855–6. In our winters generally, the thermometer does not fall below 14° to 18°, though it has been known as low as 8° above. Up to last winter the latter was thought to be the extreme of cold weather here.

"The mildness of our winters admits of large numbers of cattle being wintered on Seven, Five and Two-Mile beaches, without any provisions being made for them by their owners. In cold weather they find shelter in the thickets on the beach."

That the seaside is more comfortable in the extreme hot weather of our summers is attested by the throngs of thousands of visitors who seek comfort and relief from the heat at the many localities, long and justly famous for their attractiveness. From Sandy Hook to Cape May the whole length of beach will probably be all taken up very soon for summer homes and seaside resorts. The new places which

have sprung up since the Geological Survey's first maps appeared, form an almost continuous line from Sandy Hook to Point Pleasant. And the maps accompanying the annual reports indicate how rapid and extensive the changes are to suit the increasing patronage of our coast. The records of meteorological stations, like figures in so many places, cannot express all the peculiarities of climate, and they often fail to indicate the nicer and more delicate distinctions in the quality or tone of the atmosphere, which, especially at the seaside, impart to it its wondrous properties in building up the system. Thus, a high temperature, if not long continued, may not give great discomfort. The cool and pleasant afternoons and nights carry one over the heat of the forenoon. Again, the denser air, the presence of ozone, and the absence of impurities or poisonous exhalations, all tend to produce an effect which thermometers and rain-gauges do not measure.

As winter resorts, there are several places on and near the Atlantic coast which have acquired some notoriety, and Lakewood and Atlantic City have attracted many visitors, particularly in the months of February and March. But no part of this coast belt has a truly mild winter climate, such as that of the Bahamas and the West Indies, the southern part of California and Florida. It is not exempt

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NOTE.—The milder climate of Cape May appears in the character of its flora. In reference to the existence of plants of a more southern range, Dr. N. L. Britton, of the Columbia College School of Mines, and author of "A Preliminary Catalogue of the Flora of New Jersey," gives the following points, viz.:

(1.) "All the southern counties of New Jersey have a somewhat southern flora, and it seems true that the further south we go the more pronounced does this become.

(2.) "Although Cape May county has never been botanically explored to the extent that discoveries already made should warrant, yet it has already yielded a number of species of more southern distribution, and, so far as known, is the northern limit of the following six: Œnothera humifusa, Nutt; Galium hispidulum, Michx; Diodia Virginica, L.; Conoclinum cœlestinum, DC.; Pleuchea bifrons, DC.; Paspalum Walterianum, Schultes. These are all the southern species of the New Jersey flora at present known to occur only on Cape May, but I have no doubt that further exploration will add others to this list.

"Besides these species the following have been found on Cape May, but also in one or two other localities in the southern part of the State: Kosteletzkya Virginica, Presl; Lobelia puberula, Michx; Smilax Walteri, Pursh; Fuirena squarrosa, Michx; Panicum viscidum, Ell.

(3.) "In addition to the above lists it may be stated that there are other species of a southern character which probably occur in greater abundance in Cape May county than in any other part of New Jersey."

The Euonymus Japonica, commonly known as the *Chinese Box*, is cultivated in gardens and door-yards at Cape May City as an ornamental shrub, and appears to thrive out of doors, although it is not hardy north. In the Southern States it is common.

from sudden changes of temperature and cold, freezing weather, although for short periods, generally. And it has its fair proportion of cloudy and wet days and chilly northeasterly winds, which are features of the climate of all of our Middle Atlantic slope. And so far as climate is influenced by the percentage of relative humidity, the records of the United States Signal Service show that it is more damp or moist than the more inland belts or localities.* The tonic nature of the pure air and much outdoor exercise has, probably, more effect than the slight differences in temperature, which instrumental observation detects. Still it must be stated that as yet our meteorological observatories cannot analyze, as it were, the air, and note the small fractional percentage of constituents which may be in the air, and of which the consumption in the course of a seaside visit is, in the aggregate, comparatively potent in its effect upon the human system. These unmeasurable or rarely-noted factors may enhance the influence of a slightly milder and more equable temperature in the winter. To persons coming from New England and New York, or from the colder northwest, these seashore places appear warm and pleasant, and the change for that class of visitors is both agreeably pleasant and beneficial. And even to the residents of our large cities, whose winter temperatures are not much lower and whose climates are not greatly different, the effect of out-of-door air at the seaside is tonic.

WINDS.

The prevailing winds in the State are from the west. In the warmer months they are more southwest or south of west; in the colder months, more north of west and northwest. The unequal pressure and the differences in temperature on land and sea give rise to more northern winds in the winter season, and southern currents in the summer. In the winter the areas of high pressure, or anticyclones, over the northwest, cause the air to flow south or southeast towards the ocean for longer periods than in the summer or warm weather, when the reverse conditions prevail, and the winds from the sea flow landwards and from south quarters.†

*The relative humidity on the coast is greater in summer and less in the winter months, or the reverse of what prevails in the interior, and hence, comparatively speaking, the winter in that belt is not more moist than it is in the interior.

†The winds in storms are referred to under the head of Atmospheric Precipitation.

The mean direction of the winds for each month, as deduced by Prof. Coffin, from observations at 40 different places in Delaware, Southeastern Pennsylvania and Southern New Jersey, is given in the following table:

January	N. 81° W.
February	N. 78° W.
March	N. 83° W.
April	S. 89° W.
May	S. 89° W.
June	S. 84° W.
July	S. 83° W.
August	S. 64° W.
September	N. 89° W.
October	N. 88° W.
November	N. 79° W.
December	N. 79° W.

Here, as generally, on the middle Atlantic coast, the change in the mean direction is slight, the wind being westerly in all months, and the difference but 38° between February, when the winds incline most to the north, and August, when the most southerly direction is reached.*

The mean direction of the winds in the four seasons in Southeast New York, Eastern Pennsylvania, and North and Central New Jersey, are given in Prof. Coffin's tables.

	Spring.	Summer.	Autumn.	Winter.
Southeastern New York	N. 80° W.	S. 43° W.	N. 77° W.	N. 60° W.
North and Central New Jersey	N. 55° W.	S. 69° W.	N. 69° W.	N. 58° W.
Eastern Pennsylvania	N. 68° W.	S. 75° W.	N. 72° W.	N. 55° W.

In this table Eastern Pennsylvania may be said to represent the western part of New Jersey.

The relative frequency of the winds blowing from the several quarters is exhibited by statistics of records at various stations in the State. From a large number of observations made at Easton, Pa., Newark, Lambertville and Burlington in 1854–9, the percentage has been found to be—

* "Discussion and Analysis of Prof. Coffin's Tables and Charts of the Winds of the Globe," by Dr. Alexander J. Woeikoff, Smithsonian Contributions to Knowledge, No. 268. Washington, 1876.

North	6.46	per cent.
North and east	14.17	"
East	3.29	"
East and south	9.72	"
South	6.20	"
South and west	20.57	"
West	13.77	"
West and north	25.82	"
	100.00	

Observations in different parts of the State show variations in the relative frequency and in the velocity also. And, in general, there is a gradual increase in the frequency or percentage of southerly winds, going from the Highlands or North Jersey to the south. At the seaside there are more frequent easterly winds. The sea breezes account for much of this excess.

The observations do not, however, show fully the relative prevalence of the west winds, unless we take into account the distance traveled by them. The mean velocity of the northwest winds exceeds that of the west, southwest, or winds from other quarters. Observations ought not to be limited to direction only, but should include velocity and measure the distance traveled, also.

In mountainous regions the winds are generally controlled in their directions by the courses of the valleys and of the mountain ranges. The prevailing winds take the valleys, and they are said to blow up or down them. In New Jersey our mountains are too low, and the valleys are not deep enough, to have much effect in diverting the course of the winds, excepting in some of the very narrow depressions and over very limited areas. The southeastern slopes of some of the Highland ranges are thus shielded from the cold and northwest winds of winter. But the aggregate area of such sheltered localities is small, compared with that of the whole Highlands.

The proximity of the ocean gives rise to another disturbing agency, which is due to the different heating capacities of land and water, and it appears in the

SEA BREEZES.

Along our coast there is a belt of varying breadth in which the general direction of the wind is interrupted, during the warmer part of the year, by the inflowing currents of sea air, which are known as sea breezes. They are periodic, coming daily, with rare exceptions.

They are caused by the unequal heating of the land and water surfaces. The air over the land is heated and expands, giving rise to ascending currents. To restore the average density and to maintain an equilibrium, the cooler air over the water flows toward the land, producing an *on-shore wind.* This movement begins usually near midday, or sometimes about 11 o'clock, gradually increasing in force, until it attains a maximum velocity about 2 o'clock in the afternoon. It then lessens (as the land cools more rapidly) and ceases about nightfall, when the land or *off-shore* wind takes its place. This daily recurrence of the sea breeze is the peculiar feature of our shore, which moderates the heat, and by its invigorating sea air makes the seaside so attractive both to the pleasure-seeker and the invalid. It affects the temperature, and hence the maximum for the day at the seaside is not about 2 to 3 o'clock, as in the interior, but about noon or just before its arrival. Occasionally there is a summer day when the land wind prevails and there is no sea breeze. They are known as hot days at the shore, and probably because of the contrast with the cooler days when the sea breeze prevails. The influence of the sea breeze upon average temperatures of the summer months, and in depressing the maximum at the coast stations, is evident in the lower means and maxima at them.

The extent or limit to which sea breezes are felt from the coast line, varies considerably, according to the direction of the shore line and the contour of the surface. There is a variation in the same season and in different seasons, according to the character of the same. Generally the distance is less than ten miles, and often not more than four or five miles.* Its regular recurrence is limited to the shorter distance, or to a narrow shore belt. Cleared land surfaces which are readily heated and where there are no obstructions in the form of timber belts, allow of a further indraught of the sea breeze. The absence of hills along our coast favors its progress. Long-continued hot weather, as in summer droughts, which allow an accumulation of heat in the surface soil and the lower air stratum, seems to widen the belt considerably, and for many days together the breeze is observed at places further inland, beyond its ordinary limit, coming, however, later in the afternoon than it does on the shore.

The height to which the sea breeze reaches has been determined very recently by balloon ascensions and observations made at Coney

*See page 348 for observations on sea breezes at greater distances from the ocean.

Island, N. Y., in August, 1879, and reported with notes by O. T. Sherman, in the "American Journal of Science," Vol. XIX., pp. 300–302. The surface breeze was found to cease at a height of about 650 feet, and at 700 feet a land current deflected the breeze towards the northwest. At 800, 900, 1,000, 1,100 and 1,200 feet, the observations, with one exception, indicated winds from the northwest quarter. Under 700 feet the prevailing directions were southerly, and from both the southeast and southwest quarters. The extension of observations of this kind to points on the New Jersey coast, would be interesting and add to our knowledge of this phenomenon.

The total movement of the air, or distance traveled, varies with the velocity and duration of the wind.

In the interior of the State the winds are not often high, nor do they blow steadily at a given rate for a long time. Everywhere our winds may be termed variable, shifting slightly from point to point, and varying in their velocity. In the summer they are more gentle than in the other seasons of the year. And short seasons of calms are not uncommon. The more violent and high winds come with thunder storms. The spring and winter are marked by more windy weather, and by a greater total movement of the air. Hurricanes are unknown, and there are very few records of what may be termed tornadoes. That of June 13th, 1835, at New Brunswick, was probably the most destructive one ever felt in the State since records of such phenomena have been made.* Generally, the damaging effects of high winds are confined to narrow limits, and rarely do more than throw down crops and partially decayed trees, or occasionally unroof a building. Destructive winds, such as are reported from the Southern and Western States, are here unknown.

On the shores of our Atlantic coast and Delaware bay divisions the winds blow more steadily, and the velocity is generally greater than it is inland, where the mountains and wood serve to retard the air movement. The more isolated high peaks or crests of the Highlands are, possibly, more exposed than the coast stations, but we have no records from them. Observations and measurements elsewhere indicate this to be a fact. But at Cape May the United States Signal Office Station records frequently give a greater total movement than that of any other of their stations in the country, excepting Mount Washing-

* Blodgett's Climatology of the United States, page 403.

ton and Pike's Peak. The total movement of the air at Cape May for one month (December, 1878,) has amounted to 16,567 miles, or an average of 22 miles per hour for every hour of that month. In the winter and spring months the totals are from 9,000 to 13,000 miles, whereas in the summer months they are under 10,000 miles, and rarely exceed 9,000. The autumn months give a wider range.

At Sandy Hook, 16,954 miles were measured in December, 1876, a slight excess over Cape May. Generally, the totals for Sandy Hook are a few hundreds or a thousand miles below those of Cape May. Philadelphia, Baltimore and New York rarely report more than 9,000 miles for any month. From the "Monthly Weather Review" it appears that Cape May is the most windy of all the United States Signal Office Stations, except Mount Washington and Pike's Peak. Its position between the ocean and the bay may explain this large total air movement.

High velocities also are frequently reported from these coast stations. Rates over 50 miles per hour are quite common. At Sandy Hook, December 9th, 1876, the rate of 84 miles was observed. At Cape May, 83 miles were recorded of a northwest wind in November, 1879; 72 miles of a west wind, December 9th, 1876, and 65 miles of a wind in September, 1876. The duration of high winds, having these velocities, is short. They are the peculiar features of severe storms which move northeastward along our coast, and generally belong to the clearing-up period of the storm as it is moving away.

No records of movements or velocities from the northern or central parts of the State are known, but it is not likely that any such figures as are given here would be measured, unless on mountain tops.

BAROMETRIC PRESSURE. WEIGHT OF THE ATMOSPHERE.

No attempt has been made to collect the records of barometric observations. The diurnal, annual and secular movements are so slight as not to be taken into account in this connection, and their discussion belongs to the department of physics rather than to a popular notice of climate. The variation between localities, due to differences of elevation, is according to a general law, and the amount of this variation does not exceed two inches in our State. The barometer falls as the height increases. The rate varies a little according to temperatures, but at ordinary summer heat, say 72°,

the fall is one-tenth of an inch for 95 feet rise; at 32°, a fall of a tenth corresponds to 87 feet; but, in round numbers, the difference is about one inch for 900 feet rise. Hence, on our highest ridges the difference would be about two inches, and throughout our Highlands the depression would range from 1 to 1.5 inches. In recording barometric observations, corrections are generally made so as to reduce them to a common datum, which is that of the ocean level.

The most important barometric observations are those made during the passage of low pressures or storm-centers across our territory. These areas of low pressure are accompanied in nearly all cases by either rain or snow. And very low depressions are marked by high winds, which blow *down* steep gradients towards the center of the cyclonic storm. In the colder months the low barometric pressures are marked by moisture and precipitation, and a rise in temperature. In the summer season they are associated with a lowering of the temperature and rainfall. The high barometric pressure is characterized by reverse conditions—in the summer by great heat, and in the winter by severe cold. These *anti-cyclones* appear to move more slowly and to be of great extent, and to continue longer than the low pressure or *cyclonic* conditions. The long and very warm summer *spells*, or periods of weather, and the cold waves of the winter, are coincident, nearly with high barometric pressure.

The differences between the mean barometric measurements in the several parts of the State, excepting as modified by altitude, which has been referred to above, are too inconsiderable to affect us sensibly, and scarcely enter into the subject of our climatology. Careful observations, and long continued, may prove the existence of differences, and they may be found to affect the human organism; and the study of the sanitary relations of climate must include them.

RELATIVE HUMIDITY.

Atmospheric air always contains some vapor of water or moisture, in addition to its oxygen, nitrogen and carbonic acid gas.

When fully saturated, each cubic foot of air, at 80° temperature, holds	10.81	grains of	vapor of water.
One cubic foot, at 60°, holds.....	5.87	"	" "
Difference.....	4.94	"	" "

Therefore, when cooled from 80° to 60°, 4.94 grains will be thrown down or deposited in a liquid form as rain, or, if colder, as snow or hail. The height of the mercurial column, which is sustained by the vapor of water in the air, when saturated, at different temperatures, varies as follows:

At 32°	0.181	inch.
At 60°	0.518	"
At 80°	1.023	"
At 100°	1.918	"

The capacity is, therefore, about doubled for each rise of about 20°. Using the saturated condition or state as the standard of comparison (100), the relative quantity of moisture is expressed by percentage. The drier the air, the lower the percentage, and conversely. It is possible to make comparisons between localities, or between the different states of the air at any given place, expressing the differences in such terms of percentage. It is in such comparisons that the term *relative humidity* is employed. The instrument to measure the quantity of vapor of water is a hygrometer, and from its readings the relative humidity is calculated.

In consequence of the ever-varying rates at which the processes of evaporation and condensation go forward, the quantity of moisture in the air is subject to continual change. The extent of water surface, the elevation above ocean level, the direction of the prevailing winds, and the temperature, all combine to modify these processes and to increase or diminish the quantity of moisture. Oceanic and insular climates are generally moist or *humid,* whereas continental climates are dry. The mean relative humidity is greater on the seashore than inland.

The influence of great humidity upon vegetable growth, upon temperature and on the healthfulness of localities, is such that the determination is necessary to a full understanding of their climates. The luxuriance of tropical vegetation is generally associated with moist climates. The effect upon temperature is to make it more even, and moist climates are more equable. The moisture in the air, when it approaches saturation, tends like a screen to prevent excessive radiation at night, and to protect from the sun's rays during the day. The air itself is thereby warmed.

Although so important, the accurate determination of this element

is somewhat involved in uncertainty, since variations are found to be considerable within comparatively short distances.

The absence of records giving the relative humidity of the air at localities in the State, excepting the United States Signal Service stations, which are all on the coast, or near it, prevents any accurate comparison of the different districts of the State. In general, the relative humidity is greater at the seaside than inland, and in the southern than in the northern part of the State. The average percentage of humidity at the seaside localities, as reported by the United States Signal Office, is from 75 to 83 per cent., whereas at Philadelphia and New York the average for the year is only about 70 per cent. A notable difference in the seasons is that in the interior the four coldest months are the moist ones of the year, whereas on the coast the humidity is greatest in the summer, or from June to September, inclusive. And August has, generally, the highest percentage. The relatively drier spring and winter at the seaside is one reason for the apparently more pleasant and milder climate of Atlantic City, Cape May and other localities on the coast, in the winter, and which has attracted attention to them as winter resorts. The oppressiveness of the humid atmosphere is not as great at that season, as in a hot summer day, when the absolute amount of moisture in the air is much greater.

ATMOSPHERIC PRECIPITATION.

RAIN AND SNOW.

The average amount of rain and snow falling on any part of the earth's surface is determined by its situation, the prevailing winds, the configuration of its surface and the nature of the surface covering. And the amount of such precipitation is one of the measures of its climate. And, further, as it is distributed throughout the seasons and the year, and is in excess or is deficient, climates are, relatively, wet and rainy, or they are dry and parched. As factors of climate, the amount and the distribution of the rain and snow are the most important after that of temperature. They exercise a controlling influence in agriculture, and determine largely the kinds of crops and the modes of cultivation of the soil. They indicate the lines of internal navigation and of water-supply. And in their indirect influence upon the human system, the health and activities of the inhabitants are mightily affected.

The limits, areas and surface features of the climatic divisions of the State have been referred to under the head of Temperature. The direction and relative frequency of the winds also have been given. (*See* WINDS.)

The larger part of the annual precipitation is in the form of rain and snow, falling during the passage of cyclonic storms across the State. These storms, marked by low barometric pressure, move over the country in a general northeast course, entering from the Gulf of Mexico and passing northward and north-northeast to New England, the St. Lawrence region and Newfoundland. Others come from the northwest and west, going in a general east or east-northeast course to the ocean. Occasionally these low centers meet or coalesce, and the intensity and duration of the storm are then increased. The tracks of these centers of low barometric pressure are charted by the United States Signal Office, and their maps indicate the direction, rate of movement and the rainfall in their progress. Prof. E. Loomis, of Yale University, has studied with great care and in detail these areas of low pressure, traversing the eastern part of our continent, and has divided them into three classes:

"I. Those whose course was for some days towards the west. II. Those whose course was towards some point between the south and east. III. Those whose course was towards some point between north and east." The dates of beginning and end, latitudes, longitudes, course and velocity in miles per hour are all tabulated. The storms of the II. and III. are the ones which cross our territory. Those of the second class occur more frequently during the colder months of the year. Their average velocity is 24 miles per hour. Their course is seldom maintained as far south as 30° north latitude, after which it frequently changes to the northeast, so that they cross our territory as northeast storms also. Of the storms which cross the United States north of 38°, nearly all pursue a course a little east of north; those coming from south of latitude 38° generally pursue a nearly northeast course. The storms of this class occur most frequently in autumn and least frequently in summer. The rate of movement of the storms in this class varies from 12.4 to 60.4 miles per hour, averaging 28.4 miles. At these rates such storms would move from Cape May or Delaware bay entirely across the State in two and a half to thirteen hours, or at the average rate, in about five

hours. Or from Delaware bay to Sandy Hook the passage would be made in nearly four hours.*

The duration of the storm, or of actual precipitation, varies from a few hours, as in the case of some of the summer storms, to two or even four days, in the longer and more slowly-moving areas of low pressure. And, generally, the rain or snow comes after the fall of the barometer, and is on the eastern side of the center of low pressure, the prevailing winds being from an easterly quarter.† In the colder months of the year, from the first of December to the end of March, the precipitation is, in part, in the form of snow, especially in the northern and mountainous districts of the State. In the extreme south there is more rain, even in the winter months, than snow. And in some years the proportionate quantity of rain exceeds largely that of snow throughout the whole State for all the months. On the other hand, there is no record of a winter season passing without some precipitation as snow, though it may be scarcely more than deep enough to cover the earth.

The warm season or months of the year are marked all over the State by the occurrence of thunder storms, which move rapidly and in a general easterly course, and are local in their extent. They are more frequent in the latter part of the summer, or during the months of July, August and September. And they are more common in the afternoon or early evening than in the morning hours of the day. The relative amounts of rain falling in the course of thunder storms and that which comes with the longer cyclonic storms cannot be given in figures, as there are no statistics or records of long periods and at stations distributed over the State; but from the observations made at Newark and at a few other localities, it is evident that in many years the summer rainfall is, to a considerable extent, due to thunder storms. It must be understood that in some instances these summer thunder storms are of wide range and mark the movement of a cyclonic storm or disturbance which traverses the whole Atlantic States. They are hardly classifiable with the local thunder storms characteristic of our summers.

The amount of precipitation in any given storm has a wide variation. It rarely exceeds four inches in depth, and three inches is a

* "Contributions to Meteorology," in the *American Journal of Science*, Vol. XXI., pp. 1-8; also Vol. XXX., pp. 7-11.

† Prof. E. Loomis, in *American Journal of Science*, Vol. XXV. (1883), pp. 9, 10.

heavy rain. In the Newark record the number of rains over three inches in thirty-seven years and eight months was thirty-six. Eight of them occurred in July; eight in August; five in October; three in November; two each in December and May; and one in each of the other months. These observations indicate the greater frequency of heavy rains in the late summer and in autumn. Of special heavy rains the storm of March 19th and 20th, 1881, at Paterson, is worthy of mention, when 5.44 inches fell in eleven hours. Another still heavier rainfall was that of March, 1875, at Parsippany, Morris county. F. A. Wilber (now of Rutgers College Faculty) kept a record at that time, and measured seven inches of rain and melted snow coming in a single storm. The greatest freshet ever known in parts of eastern Monmouth county, July 11th, 1871, was caused by a shower which did not last more than three hours. The fall during the extraordinary shower between Trenton and Bordentown, on August 24th, 1877, was thought by Dr. C. C. Abbott to be about nine inches.* No doubt other equally great and sudden rainfalls could be included in this list if records were more generally kept.

* Dr. C. C. Abbott, of Trenton, furnishes the following graphic account of this rain, written at the time, while every feature of it was still fresh in memory: "Previously to 1:30 P. M. the day offered no peculiar meteorological features. The temperature was 78° Fahrenheit at noon, wind southeast. About 1:30 P. M. the wind shifted to the southwest, and a heavy bank of blue-black clouds formed in the northwest. The appearance at this time was that of an ordinary summer shower. I did not notice any lightning or hear any distant thunder. While standing on the brow of the hill near where my house stands, and facing the southwest, I noticed that a somewhat similar bank of clouds to that in the southwest was also rapidly forming, and the two appeared to be approaching each other, although not from opposite directions, of course. * * * In a few moments there was a sudden change in the several conditions then obtaining. The stiff, northwest breeze suddenly ceased. A remarkable stillness pervaded the atmosphere and a feeling of oppression was very noticeable. * * * Just at this time the two masses of clouds came in contact, apparently, (and really, I think,) directly over the extensive stretch of meadows lying north of Bordentown, along the Delaware river. At the moment of contact of these cloud masses there was a loud, humming sound, clearly audible, *but not caused by a wind, the leaves were motionless.* The two masses formed one, but retained their peculiar coloring, and in less than a minute, I should think, a huge water-spout formed—or, at least, the clouds became a single conical mass, with the apex downwards. As suddenly as it formed it broke, and, in ten minutes, at most, thereafter, the meadows were flooded. The storm now took the form of a general rain and extended over a considerable area. Such a rain, however, I never previously or since have witnessed. I found by experiment that it was impossible to breathe while facing it, unless by protecting my nose and mouth with my hand. At a distance of 100 feet objects were wholly obscured from view. This fearful rainfall continued for about forty minutes

As has been said of the larger area of the eastern United States, "the distinguishing feature of the distribution * * * is its symmetry and uniformity in amount over larger areas." * It is possible to construct rain charts, using the longer records only. And such charts of the United States have been published by the Smithsonian Institution and the United States Signal Office. The mean annual rainfall for that portion of the Atlantic slope occupied by New Jersey, ranges from 42 to 46 inches. These figures correspond with those for the Middle Atlantic States. In the South Atlantic and Gulf States the yearly amount is somewhat greater; whereas, in the New England States and in the lake districts the average is a little less than in New Jersey. The excess in the former and the deficiency in the latter, as compared with New Jersey, are in the rainfall during the warm months rather than in the colder part of the year; and they are owing to the more severe and heavy summer thunder storms of more southern districts and States.

The table of rainfall appended gives the amount of rain and melted snow in inches at the stations where records have been kept. These stations or localities are distributed irregularly, and they leave wide gaps, especially in the northern part of the State, where no observations have been made, and which leave some doubts about the local differences in amount. For the Highlands, there is a valuable record at Lake Hopatcong. It was kept by the Morris Canal Company, and for 24 years (1846–1869). West Point and Goshen, N. Y., and Easton, Pa., have been added to represent the Highlands valleys and the Kittatinny valley. New York City and Fort Columbus give long records for comparisons. In the Red Sandstone plain there are comparatively long records at Newark, New Brunswick and Lambertville. The Morrisville and Philadelphia records are used, as they are so near our borders, and are of great length. In the southern interior, we have good records from Moorestown and Vineland. Dover, Del., and Baltimore, Md., have been added for comparisons with the Greenwich record, which is short. For the seacoast the records at Sandy Hook, Barnegat, Atlantic City and Cape May, ranging from twelve to fourteen years, give a fair average and permit comparisons, as they cover nearly the same years of the period, from

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and then began to abate, but it was not until 5 P. M. that the rain ceased and the sky became comparatively clear. This storm was remarkable for one feature other than that of the quantity of water that fell; this was the absence of lightning."

* Blodgett's "Climatology of the United States," p. 317.

1874 to 1888. The difference of latitude between the extreme northern and southern stations is 2° 28′, or 170 miles.

The records for short periods of observation are less valuable than the longer series of the table, on account of the probable error, or variation from the true average or normal quantity. According to Schott's tables,* this limit of error amounts to 1.4 inches in a series 30 years long at New York; 0.6 inches in a forty-three-year series at Philadelphia, and in case of a single year to 12 per cent. Hence the difficulty in comparing places having short series of observations.†

For comparison of the broader features the following tables of stations, selected as representative of the north and south and the east and west sides of the State, are inserted. In the first table the stations in the northern part of the State have records ranging in length from that of New Germantown, 7 years and 10 months, to that of Newark, 45 years and 8 months. For the southern part of the State, Philadelphia, Pa., and Dover, Del., are inserted. And the records vary from periods of 9 years and 8 months at Dover, to 63 years at Philadelphia. The comparison of the eastern and western sides of the State is made in the second table. The selected stations have periods ranging from 8 to 63 years in length.

These comparative figures show that there is more rain and snow (total precipitation) in the southern than in the northern parts of the State, and that the excess is greater in the summer than in the winter months. As none of the stations are either on the ocean or in the mountainous districts of the State, they may be considered as representing fairly the differences due to the two sections, irrespective of local influences arising from surface features and peculiar situation.

The difference in the quantity of rain and snow on the eastern and western sides of the State, respectively, leaving out of the comparison the shore stations, is more marked than that between the north and south. It amounts to an excess of 1.3 inches for the four colder months, 1.7 inches for the four warmer months, and 3.7 inches for the year at the stations in East Jersey. If the shore stations were included in the table, the difference would be greater than it is here shown to be. Hence the normal lines of equal precipitation, if drawn

* "Tables and Results of the Precipitation in Rain and Snow in the United States."—*Smithsonian Contributions to Knowledge, Washington, 1872, No. 228, p. 144.*

† The errors from gauges inaccurate and not properly located are evident in some of the discrepancies of the shorter series; but it is impossible to eliminate all of them. Some obviously incorrect records have been omitted.

Rain and Melted Snow, for Comparison of North and South. Expressed in Inches.

North.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Newark	3.65	3.60	3.81	3.53	3.97	3.57	4.28	5.07	3.75	3.58	3.63	3.81	45.95
Fort Columbus, New York Harbor	3.29	3.23	3.34	3.16	4.31	3.92	3.62	4.48	3.39	3.30	3.27	4.03	43.34
New Germantown	3.08	2.78	3.76	3.24	3.29	4.03	4.71	4.95	3.13	5.01	3.67	2.44	44.09
New Brunswick	3.07	2.97	3.38	3.75	3.82	3.89	4.63	4.94	3.39	3.33	3.64	3.47	44.31
Lambertville	3.22	3.12	3.25	3.16	4.12	3.76	4.26	4.83	3.68	3.33	3.11	4.08	43.92
Means	3.26	3.14	3.51	3.37	3.90	3.83	4.30	4.85	3.47	3.71	3.46	3.57	44.32

South.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Moorestown	3.44	3.50	3.39	2.92	3.77	3.93	4.18	4.43	3.82	3.18	3.25	3.42	43.23
Philadelphia, Pa	3.29	3.08	3.42	3.47	3.73	3.96	4.03	4.47	3.57	3.21	3.37	3.43	43.03
Atco	3.73	3.36	4.25	2.85	2.93	4.15	4.07	5.87	4.76	2.96	3.93	3.90	46.76
Vineland	4.60	4.06	4.43	3.12	3.76	3.52	4.25	5.09	4.38	3.33	3.72	4.01	48.27
Dover, Del	2.66	3.15	4.94	2.99	2.82	3.24	5.04	4.95	4.39	2.78	3.98	3.01	43.95
Means	3.54	3.43	4.09	3.07	3.40	3.76	4.31	4.96	4.18	3.09	3.65	3.55	45.05

Rain and Melted Snow, for Comparison of East and West. Expressed in Inches.

East.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Paterson	4.17	4.83	5.51	3.06	5.01	5.59	6.15	4.16	5.57	2.98	3.06	4.96	55.05
Newark	3.65	3.60	3.81	3.53	3.97	3.57	4.28	5.07	3.75	3.58	3.63	3.81	45.95
New Brunswick	3.07	2.97	3.38	3.78	3.82	3.89	4.63	4.94	3.39	3.33	3.64	3.47	44.31
Fort Columbus	3.29	3.23	3.34	3.16	4.31	3.92	3.62	4.48	3.39	3.30	3.27	4.03	43.34
Freehold	3.97	3.75	4.97	3.41	2.78	3.91	3.92	5.02	4.48	3.06	3.69	3.77	46.73
Means	3.63	3.28	4.20	3.39	3.98	4.18	4.52	4.73	4.12	3.25	3.46	4.01	47.08

West.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Lambertville	3.22	3.12	3.25	3.16	4.12	3.76	4.26	4.83	3.68	3.33	3.11	4.08	43.92
Morrisville	3.29	2.77	3.33	3.87	3.94	4.09	3.62	4.05	3.48	3.65	4.28	3.29	43.66
Fallsington, Pa.	4.29	4.90	3.07	2.60	3.52	3.65	3.74	4.41	3.27	3.92	2.91	3.57	42.85
Philadelphia, Pa.	3.29	3.08	3.42	3.47	3.73	3.96	4.03	4.47	3.57	3.21	3.37	3.43	43.03
Moorestown	3.44	3.50	3.39	2.82	3.77	3.93	4.18	4.43	3.82	3.18	3.25	3.42	43.23
Means	3.51	3.47	3.29	2.20	3.81	3.88	3.97	4.43	3.56	3.26	3.38	3.56	43.34

on a State map, would have a course which is a resultant between north and east, or a northeasterly trend, and approximately parallel to the coast line. That is, there is an increasing rainfall in going from northwest to southeast. But this generalization, or law, has many exceptions. The elevation above tide-level, the relative position of land and water, of mountains and valleys, and the surface covering, or forests, all modify the effect of position. And the records are so incomplete that a few only of the exceptions and the characteristics of the several great natural divisions of the State can be given at this time. The discussion is here of the deductive type, from the natural features and topography as guides, rather than one wholly from meteorological data. The Highlands are best represented by the record of Lake Hopatcong. Its average annual rainfall is 42.5 inches, or 3.4 inches less than that of Newark. And this difference corresponds with the decreasing quantity on going northwest into New York. Goshen, in the valley west of the Highlands, appears to have a considerably lower quantity—an average of 33.82 inches in eight years' observations. Easton's ten-year record gives a mean of 46.1 inches. From the shape of the country it appears reasonable to believe that both of these records are not far from the correct means, and that there is a difference of at least seven inches between them in the year. But a further examination of the two by months shows that the difference is due to the relatively greater rainfall in the summer and autumn months. It would be expected that in the Highland valleys the larger rainfall would be in the warmer seasons, whereas in the broader Kittatinny valley the more uniform surface, and the greater area bared of forest, would show a deficiency. The five-year record at Dover, Morris county, in a narrow and rather deep valley, also shows a large summer rainfall, while the other seasonal averages agree closely with those of Easton, Pa. The single record in the Delaware river valley, beyond the Kittatinny mountain, is that kept at Port Jervis, New York. Although outside of the Highlands proper, it represents a deep valley in the mountainous belt, west of the great Kittatinny valley, and the extreme northwest section of the State. Its annual average rainfall, from a five-year record, is 39.2 inches, or 9 inches less than that of Dover, and 7 inches below that of Easton, Pa. In the absence of longer records it is not possible to express in figures the full influence of our mountains upon the rainfall. Their elevation and generally wooded slopes, as com-

pared with the deep, low-lying and cultivated valleys, must tend to condense the moisture of passing clouds and thereby produce an increase in the mean quantity precipitated upon their crests above what falls upon the adjacent valleys or plains. And the variation is most likely to be greatest at the southwest and south, on the border near the Red Sandstone plain. As stated on a preceding page, the precipitation on the hills is frequently in the form of snow, when it is rain in the valleys. The depth of snow is known to be greater on the higher grounds than in the valleys. But we have no records of any measurements.

In the Red Sandstone plain the two long series of Newark and New Brunswick differ by 1.6 inches in the average for the year. New Germantown, near the Highlands border, agrees closely with that of New Brunswick. There appears to be a greater quantity at Newark in the winter and the early spring months. In this particular, Newark corresponds with all the stations on the eastern side of the State in their greater average rainfall. The Lambertville seventeen-year record agrees with that of New Brunswick very closely by seasons and by the year. And the general correspondence between New Brunswick, New Germantown and Lambertville yields a very fair average for the central and western part of this division of the State. The forty-four-inch line would include it all. The South Orange record corresponds quite closely with that of Newark in all the yearly divisions.

The record at Paterson shows an apparent excess of nearly nine inches a year above that of Newark, and which is distributed through the winter, spring and summer months. Some of the monthly totals are abnormally large.* The situation of Paterson, in the gap in the First mountain, where the Passaic river crosses the trap-rock ranges, falling over this barrier, to the plain country on the east and northeast, may account for this apparent exception.

For the southern part of the State, the Moorestown record is one of the best, running nearly a quarter of a century. Its yearly average is 43.2 inches, and it corresponds closely with the sixty-three-year period observed at Philadelphia, whose mean is 43.0 inches. The close agreement between these places for months, seasons and year is noteworthy, and they may be taken as approximately correct averages

* That of March, 1881, was 16.1 inches, of September 1882, *25.98 inches*, or greatest in all of our records for a single month. The rainfall at Newark for the same month was 17.66 inches.

for these divisions of time. Going south, the Atco record does not differ much from that of Moorestown, excepting in the summer and September, when there seems to be a greater fall at Atco. The yearly average is 3.5 inches greater than at Moorestown. At Vineland the average is 5 inches greater, and this excess appears to be distributed, not through the warmer months, but through the winter and spring months. Thus, from December to March, inclusive, the excess amounts to 3.8 inches. Further observations are wanted to establish these differences.*

The seashore is represented by the four United States Signal Service stations, Sandy Hook, Barnegat, Atlantic City and Cape May. Inasmuch as the periods of observation are nearly identical, their comparative figures are suggestive of local peculiarities. The yearly average precipitation at these places is as follows:

	Year.	Spring.	Summer.	Autumn.	Winter.
Sandy Hook	51.1	13.8	13.1	12.0	12.2
Barnegat	48.3	10.8	12.3	12.5	12.7
Atlantic City	42.5	9.6	11.2	10.0	11.7
Cape May	47.1	10.8	12.9	10.9	12.5
Average for three stations	48.8	11.8	12.8	11.8	12.4

The average, exclusive of Atlantic City, which appears to be phenomenally low, is nearly 49 inches, or from three to six inches above what falls at the southern interior stations of Freehold, Moorestown and Atco. Even with Atlantic City included, the yearly average for the shore is 47.5 inches, indicating still an excess of 2.5 inches above the average given for the southern stations in table on page 368. As to the monthly and seasonal distribution of this excess for the seashore, it is mainly in the winter and spring months. The summer and autumn averages compare closely with the same seasons at Philadelphia.

To show the annual fluctuation or distribution of rain among the months, the mean monthly values of twenty stations, each of whose periods exceeds five years in length, were charted in five groups. The

*The common errors in placing rain-gauges, or the differences in their form, or inaccurate measurements of the fall, may account for these figures.

curves representing the several stations were assumed as types of their respective localities. The stations of the northern and central parts of the State all agree in a maximum rainfall in August, the curves reaching their highest point in that month. In nearly all of them were three depressions or minima, viz., the first in February, a second in May or June, and a third in October. A second but lower maximum was noted in the spring, in March and in May. The average of all corresponds somewhat with that expressing the annual fluctuation for the Atlantic coast, from Portland, Me., to Washington.* According to this more general curve, May and August are the wettest months, then come November and December, while February, June, September and October are relatively drier. West Point, N. Y., Lake Hopatcong, Fort Columbus, Newark, New Brunswick, Lambertville and Trenton are expressed by this curve. Goshen shows exceptions in depressions for April and November. The stations of the southern interior, and the Atlantic coast and Cape May *provinces*, yield curves which vary somewhat from the above in the spring maximum, coming two months earlier in the year, and the succeeding minimum is in May instead of June. The October minimum is also more pronounced. And in these respects the type for the southern part of the State approaches that for the Atlantic coast (Virginia to Florida).† The wet months are, first, August, then March, and the drier months are May, second, October, and then February. The southern part of the State has its first dry period earlier in the year, and the second is one month later. These correspond with the longer season at the South. Greenwich appears exceptional in having a wet May, but longer observations may remove this apparent exception.

EXTREME PRECIPITATION AND DROUGHTS.

The following tabular statement of extreme rainfalls by months and years, at stations having long records, shows the extreme variation in amount, and the wide range even for a period of one year in length :

* "Smithsonian Contributions to Knowledge," No. 288, p. 129.

† The rainfall of the coast stations of the United States Signal Service in Virginia, North Carolina and South Carolina is greater than in New Jersey—the average annual precipitation at Cape Henry, Norfolk, Hatteras, Kitty Hawk and Charleston being 59.8 inches. Examined by months, the greater fall is in July-September, and, second, in December-January; the dry months are May-June and October-November. This greater fall corresponds with the greater amount at the coast stations, Sandy Hook, Barnegat and Cape May.

Table of Extreme Monthly Rainfall, in Inches and Hundredths.

	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.
Lake Hopatcong.	5.15	0.48	5.84	0.40	7.54	0.40	7.35	0.25	7.69	1.89	7.64	0.93	7.91	0.90	10.70	0.50	11.44	0.35	9.82	1.04	8.46	1.61	7.80	0.60
Newark.....	6.52	0.64	6.07	0.82	10.00	0.98	8.71	0.39	8.74	0.76	9.74	1.04	8.94	1.12	22.48	0.28	17.66	0.25	7.73	0.32	8.74	0.87	7.54	0.92
New Brunswick..	5.37	0.64	6.01	0.46	6.04	0.80	9.22	1.88	7.57	0.65	10.90	0.24	10.42	1.26	11.52	0.70	8.61	0.34	8.53	0.00	8.77	0.00	5.95	0.96
Moorestown.....	5.82	1.13	5.96	0.56	5.78	1.42	8.40	1.15	7.38	0.47	7.56	1.61	6.97	1.98	9.29	1.26	8.27	0.67	6.83	0.47	6.30	1.52	5.77	0.90
Vineland.....	6.30	1.30	6.25	1.73	6.84	1.22	8.32	1.73	8.45	0.77	5.59	0.60	9.82	1.85	10.64	1.28	9.91	0.69	6.75	1.08	7.24	1.49	7.52	1.88

Extreme Annual Rainfall.

	GREATEST.	YEAR.	LEAST.	YEAR.	LENGTH OF PERIOD.
Fort Columbus	65.51	1837	27.57	1836	24 years.
Lake Hopatcong	54.61	1850	30.06	1866	24 "
Newark	57.31	1859	34.07	1856	45 "
New Brunswick	59.95	1873	30.33	1876	27 "
Lambertville	57.36	1841	32.32	1856	22 "

This table gives the extreme monthly precipitation from none (no measurable quantity) to 22.5 inches, and for the years the least and the greatest are 30.1 inches and 65.5 inches respectively. The extreme annual variation at Newark amounts to 23.2 inches; at New Brunswick to 29.6 inches, or about as much as the lowest annual fall. As the dry months or years do not generally occur consecutively, the severity of the droughts thus occasioned is not so great as it might be. But droughts running over three to four months occur. One of the most severe droughts felt in the northern part of the State was that of 1881. The following account of it is taken from the report for October, at Newark: "The year 1881 will ever be remembered for its remarkable drought. The fall of rain in July was 1.34 inches, the fall in August only 0.28, the fall in September 0.87, and the fall in October 2.23 inches, making a *total for four months of only 5.22 inches.* The least quantity *for the corresponding months of any year* since 1843, inclusive, was 10.08 inches, in 1848; the greatest, 34.28 inches, in 1843 (the quantity in August of that year, 22.485 inches, being unprecedented), and the mean of the 38 years 17.028 inches."* At Paterson the total rainfall for July to October, inclusive, that year, amounted to only 7.8 inches, or only 45 per cent. of the average fall for these months.

The rainfall in the southern and on the western sides of the State was heavier than at the northeast, but the severity of the drought was distressing to farmers, and water was very low in the streams. The effect upon the Delaware river was noticed in the very low stage of the water. "In the fall of 1831, and before the feeder of the Delaware and Raritan canal was located, the water of the Delaware was lower than it had been for many years. Conrad White, at that time engineer of the canal company, requested Col. Simpson Torbert to make permanent recording marks along the river shore, which he did, assisted by Martin Coryell. One of these marks was made upon the New Jersey abutment of Centre bridge, on the lower or down-stream side, being twelve feet above the surface of the water at the bridge. Mr. George Van Camp, supervisor of the canal feeder, had levels taken in November, 1879, and also in September, 1881, to compare the elevations of low-water mark one with the other, and found them as follows:

* *Sentinel of Freedom.*

1831.....12 feet below mark.
1879.....12.5 " "
1881.....13.215 " "

At Vineland the rainfall for July, August and September amounted to 6 inches, as compared with the average of 14.2 inches. And there were two periods of 21 and 22 days respectively when no rain fell.

At New Brunswick the drought continued until November, and the rain in 123 days was in all only 2.9 inches.

The following table of droughts or *dry periods*, kept at Lake Hopatcong, by W. H. Talcott, C.E., is here pertinent:

Of Droughts shown by Records kept at Lake Hopatcong, January, 1846, to December, 1869.

YEAR.	FIRST DAY.	LAST DAY.	LENGTH.	RAINFALL IN TIME.
1847	Mar. 27.	May 30.	65 days.	1.53 inches.
1848	" 12.	" 2.	52 "	1.95 "
"	July 4.	Sept. 13.	72 "	1.84 "
1849	Dec. 31 ('48.)	Mar. 20.	80 "	2.37 "
"	May 31.	July 20.	51 "	1.57 "
1851	July 25.	Oct. 29.	98 "	4.79 "
1855	Jan. 29.	Mar. 16.	47 "	0.65 "
1856	" 6.	Apr. 19.	105 "	2.66 "
"	June 19.	Aug. 3.	47 "	0.95 "
"	Sept. 29.	Nov. 21.	53 "	1.70 "
1858	Feb. 21.	Apr. 8.	47 "	0.40 "
1864	Dec. 30 ('63.)	Mar. 1.	63 "	1.44 "
1867	Aug. 29.	Nov. 30.	92 "	5.01 "
1868	Nov. 30 ('67.)	Apr. 4.	127 "	4.49 "

The most severe and long-sustained droughts in this record were those of 1856, 105 days, with but 2.66 inches of rain, and those of 1867 and 1868, the latter covering 219 days, or equivalent to seven months, and receiving 9.5 inches of rain and snow over the cold half of the year.

For notes of droughts in the earlier period of the State's history, see appended Chronological Notes of the Weather.

SNOW.

The *depth* of snow is not indicated in the above tables and statements of rainfall, since it is measured melted, as so much water or rain. The depth varies greatly from winter to winter, and in the same winter in different parts of the State. The quantity in the Highlands is much greater than it is in the extreme southern counties, and it lies for a much longer time, and later in the spring. We have no records of the depth in the more northern parts of the State. The measurements of Mr. Whitehead, at Newark, range between 6 feet 3 inches in the winter of 1867–8, and 1 foot 2 inches in that of 1877–8; and they give an average depth for thirty-seven winters of 40 inches. The average depth measured at Lambertville during the years 1839–1859, inclusive, was 29.5 inches. It is probable that the average for the Highlands corresponds nearly with that of Northern Pennsylvania, which is put at 60 inches for the winter season. The sleighing season continues for several weeks every winter in the Kittatinny valley and the Highlands. In the Red Sandstone plain it is shorter; and in the central and southern part of the State a winter may pass with only a few days of snow depth sufficient for sleighing.

The variation between localities is illustrated in the differences between Paterson and Freehold during the winter of 1880–1. At the former place the total fall of snow was 48 inches; at the latter it amounted to 77 inches, exceeding the greatest depth at Newark by 2 inches.

The snow melts much more rapidly near the coast than in the interior, and although the depth of fall may amount to nearly as much, sleighing is rarely possible beyond a few days at a time; and on the beaches, as at Atlantic City, sometimes for a single day only. And frequently the storms which begin with snow, end in rain. But the sea wind appears to have a very powerful effect in causing it to melt rapidly.

Snow is confined to the three winter months, and to November, March and April. April snows are generally light and infrequent. And the November falls often do little more than whiten the ground. In the Highlands snow may be expected about the first of

December; in the southern part of the State, snow deep enough to lie for several days rarely comes before Christmas. According to the Hazard "Register of Pennsylvania" there was a snowfall at Philadelphia, May 8th, 1803, which broke down trees which were in leaf. But that occurrence is the sole one of a century or more.*

SANITARY RELATIONS.

The climate of New Jersey, as a whole, is salubrious. It is more equable than that of the same parallels further west. And yet it is not the equability accompanied by great moisture and dampness, or cold, which may make an even temperature undesirable and unhealthy. The extremes of temperature, or the range, are not so great as in the northern part of New York and New England generally. The lowest temperatures of our winters are not so low by 10° to 20° as in these States to the north. And diseases of the respiratory organs are neither so prevalent nor so acute and fatal. Persons from New England and New York find the climate of the southern part of the State more comfortable and beneficial in the case of any predisposition to lung diseases. Lakewood, Vineland and Atlantic City have become winter resorts for this class of patients, who escape the rigors of a more northern climate. For evenness of temperature, Cape May has already been indicated as a remarkable locality, and the advantages of so equable a climate within our borders deserve the attention of all interested in the study of medical geography, or in exemption from the extreme cold and sudden changes of our winters. In general, our seaside is so accessible, and so well provided with comfortable and luxurious accommodations, that many prefer to go there rather than further south, and find it quite as beneficial. The growth and prosperity of Atlantic City are largely owing to its winter homes and its patronage throughout the year. These seaside towns are so easily and quickly reached that they are becoming the homes for many invalids and delicate people, who cannot live further inland, where the extremes of both heat and cold are more intense and trying.

On the other hand, our climate is not like that of the Southwest and South Atlantic Coast States, in the heavier summer rainfall and

*The storm of March 11th–14th, 1888, was remarkable for its severity and the depth of snow. (See Chronological Notes appended.)

prolonged heat periods. The heated terms are shorter, and the nights are cooler than at the South, and, consequently, they are not so enervating or exhausting. There is less malarial fever, so prevalent and fatal along the more southern Atlantic coast and in the Gulf States. Our seaside offers the escape from the extremes of heat also, and it is thronged during the whole summer by a large population seeking comfort and health.

Taking the year through, our situation is favorable so far as climate is concerned, and the records of longevity are evidence of the general healthfulness of our State.

The diversities of climate within the limits of the State must have their effect, and the general healthfulness is modified more or less by these varying conditions. The equable character of the coast and its sanitary advantages have been mentioned above. In the northern part of the State the Highlands offer many locations where the air is very bracing and dry, and where there are no swampy tracts or wet lands to give rise to any dampness or malarious exhalations. It would be beyond the scope of this article to mention localities. The general statements of the preceding pages indicate the districts.

In the southern interior, the dry, sandy soil, and the extensive pine forests, appear to conduce to healthfulness, and a few localities were noted long ago as *sanitariums* for persons with weak lungs.

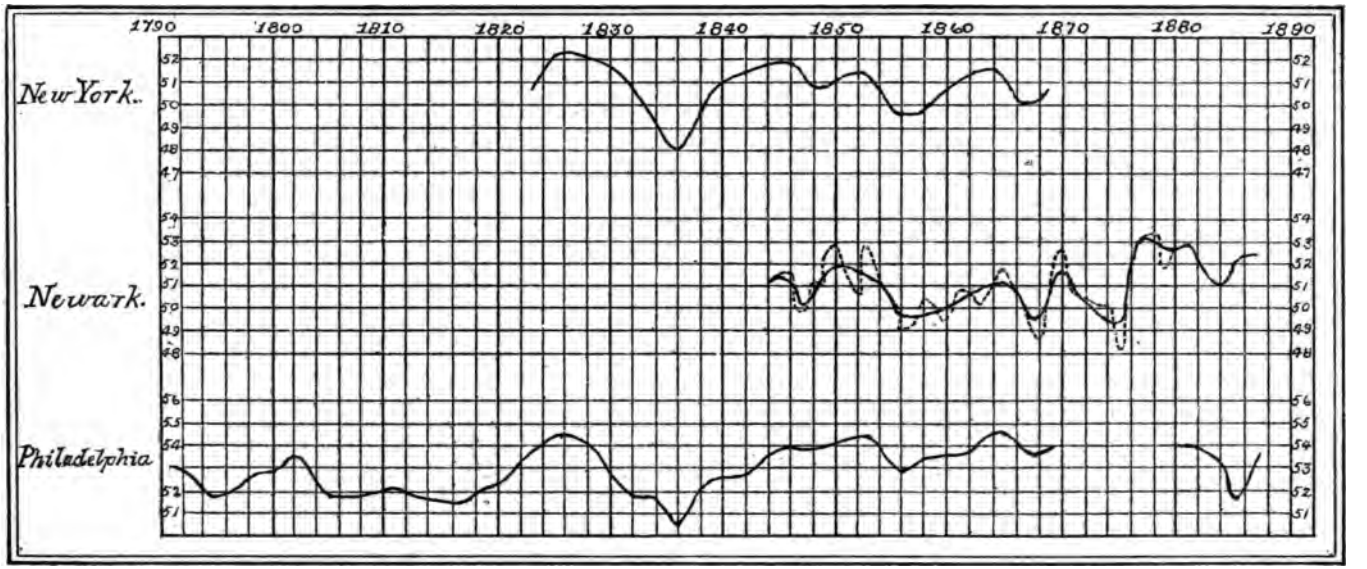
In conclusion it may be said that the study of climate in its sanitary relations is still in its infancy. This is largely due to the absence of accurate meteorological data and a general ignorance of the peculiarities of our climate. The study of disease and of climatological conditions must go together. The claims of a suffering humanity call for all the aid which science can give. And it may be found that in our own borders there are many of the peculiar conditions and local features which can be of service not only in prolonging life, but also in restoring health, quite as well as the famous resorts of the South or far West. The field is an inviting one, and encouraging of success.

PERMANENCY OF CLIMATE.

There is a prevalent impression that the climates of the globe have undergone material changes within the historic period, or since records of observations on temperature and rainfall have been kept;

and that changes are still in progress. It is generally believed that in our country the alternations of temperature are more sudden and the extremes greater; that the springs are earlier and the seasons, in general, more variable; that the rainfall is less and more unequally distributed through the year, and, consequently, that the river floods are higher and the variations in springs and streams more irregular than formerly. In Europe, the changes in climate have been thoroughly discussed by Humboldt, Dove, Glaisher, and other eminent meteorologists. Both the fluctuations in temperature and those of rainfall have been investigated. The results do not indicate any changes, or any regular variations, or cycles of definite length, although there are found to be comparatively short rainfall periods, which correspond somewhat with observed sun-spot periods. It is doubtful if even these will prove coincident throughout when tested by longer series of observations. The fluctuations of temperature do not appear capable of resolution into any orderly arrangement. Warm and cold terms of years, of varying lengths, alternate irregularly. The weather records of our country do not go back so far as some of the European series, but they also exhibit the same apparent irregularity in the sequence of warm and cold years and a lack of any periodicity in the annual rainfall. Our temperature records are mostly confined to the present century. Those of New Haven date from 1780; those of Philadelphia from 1758 (with some gaps in the eighteenth century); those of New York from 1821. In the investigation of the secular variation in temperature, the annual means for the stations having long records, have been plotted, and their curves presented in plate facing page 310 of Schott's Tables of Atmospheric Temperature. Two of the curves, those for Philadelphia and New York, are reproduced in Plate 2, and with them that of Newark for its term (1843–1887). The general curve and also the yearly irregularities or departures from it are shown, the former by a continuous, the latter by a broken line. The vertical lines represent two-year periods, and the decades are indicated by figures at the top, beginning with 1790. The horizontal lines are for temperature, the figures for which are at the sides of the diagram. They stand for *mean* annual temperature. We note a depression about 1794, in the Philadelphia curve, then a rise to a maximum in 1802. From that year to 1816 there was a general decline. Thence, onward, for ten years, the mean temperature increased quite rapidly, and here the

PLATE 2.



CURVES OF SECULAR CHANGE IN THE MEAN ANNUAL TEMPERATURE

New York curve begins; both then as rapidly fall, and reach a very decided minimum in 1836. From that depression the Philadelphia curve rises irregularly to a maximum about 1853. Both cities show a depression about 1856–7; and the same appears in that of Newark, also. From that forward the undulations, as shown in Newark, are shorter, and there are notable depressions for the years 1867–8, and again in 1875. The rise thence to 1877–80 and the decline from 1882 to 1885 are also remarkable. The cold epochs were therefore 1794, 1816, 1836, 1856–7, 1867–8, 1875 and 1884, or at intervals of about 22, 20, 21, 11, 7 and 9 years. But the subject of change of climate is best stated in Schott's conclusion: "There is nothing in these curves to countenance the idea of any permanent change in the climate having taken place or being about to take place; in the last 90 years of thermometric records, the mean temperatures showing no indication whatever of a sustained rise or fall. The same conclusion was reached in the discussion of the secular change in the rainfall, which appears also to have remained permanent in amount as well as in annual distribution."*

Going back quite as far as any of our temperature observations, are the records of seasons of navigation and ice in rivers and harbors. One of the best is that of the season of navigation in the Hudson river. The dates of opening and closing of the river at Albany, N. Y., indicate the severity of the winter, by the longer periods, or the mildness, by the shorter time, between the closing by ice in fall or winter, and the spring date when the river was again free from ice.† This table will be found appended to this article.

None of the records indicate any diminution in rainfall in the mean quantity for year or seasons, nor does there appear to be an increased number of dry periods. In severity the drought of 1881 was certainly extreme. From the clearing away of forests, particularly in the Red Sandstone plain, and the general cultivation of the soil, drainage of wet tracts, etc., it is reasonable to suppose that the rainfall might be slightly diminished in quantity, judging by the well-known comparative observations on rainfall in forests and in

*"Tables of Atmospheric Temperature: Smithsonian Contributions to Knowledge," No. 277, p. 311. Washington, 1876.

†Although Albany is 100 miles north of our boundary on the north, the condition of the ice in the Hudson marks our winters—of Northern New Jersey—quite as well as any other record which we could have, and hence it is here inserted as applicable to our State.

cleared areas, in Germany, France and Switzerland. But the records do not show any such desiccation in the climate, nor will measurements, as usually made, exhibit the probable changes. The distribution of the rains through the months and seasons is probably less uniform since the settlement and clearing of the country. That is, they are more irregular, and heavy rainfalls are probably more common. Of course the rains run away more quickly, and that the streams, especially the larger rivers and creeks, are more subject to very high freshets, appears to be generally conceded, and reasonably so, since there is a vastly diminished area of swamp and woodland to retain in the surface the rains, and to allow their more gentle flowing away. The drying up of springs, supposed to be lasting, and of streams which formerly carried water even in very dry seasons, are evidences of the greater *desiccation* of the soil at times, if not of the climate. (See Marsh's "Earth as Modified by Human Action.")

HISTORICAL NOTES OF CLIMATE AND WEATHER PHENOMENA.

The earliest printed notice of the climate of New Jersey is in "A Description of the Province of New Albion, etc., published in 1648." The following extract from it is here given: "Whereas that part of America, or North Virginia, lying about 39 degrees on Delaware bay, called the province of New Albion, is situate in the best and same temper as Italy, between too cold Germany, and too hot Barbary; so this lying just midway between New England 200 miles and Virginia 150 miles south, where now are settled 8,000 English, and 140 ships in trade, is freed from the extreme cold and barrenesse of the one, and heat and aguish marshes of the other, and is like Lumbardy, and a rich fat soil, plain, and having 34 rivers on the mainland, 17 great Isles, and partaketh of the healthiest aire and most excellent commodities of Europe, and replenished with the goodliest woods of oaks and all timber for ships and masts, mulberries, sweet cypresse, cedars, pines and firres, 4 sorts of grapes for wine, and raisins, and with the greatest variety of choice fruits, fish and fowl, stored with all sorts of corn, yeelding 5, 7 and 10 quarters an acre."*

* That the name New Albion was then applied to New Jersey appears in a letter of Robert Evelin, which was included in the same pamphlet. We extract: "But nevertheless to satisfie you of the truth, I thought good to write unto you my knowledge, and first to describe you from the north side of Delaware unto Hudson's river in Sir

From the account of Thomas Rudyard, Deputy Governor of East Jersey, written in 1683, we extract the following paragraph, descriptive of that Province: "As for the temperature of the air, it is wonderfully situated to the humors of mankind; the wind and weather rarely holding one point, or one kind, for ten days together; it is a rare thing for a vessel to be wind-bound for a week together, the wind seldom holding in a point more than 48 hours; and in a short time we have wet and dry, warm and cold weather." This description is as pertinent to-day as it could have been in 1683.

In Thomas Budd's "Good Order Established in Pennsylvania and New Jersey in America," printed in 1685, there is the following: "The dayes in the winter are about two hours longer, and in the summer two hours shorter than in *England;* the summer somewhat hotter, which causeth the fruits and corn somewhat to ripen faster than in *England*, and the harvest for Wheat, Rye and Barley, being about the latter end of *June.* In the winter season it is cold and freezing weather, and sometimes Snow, but commonly very clear and Sun-shine, which soon dissolves it."

Peter Kalm, a celebrated Swedish traveler and natural philosopher, who spent the winter of 1748–9 in West Jersey, and afterwards, in 1750, traveled through the State, writes as follows of the snow at Penn's Neck, February 23d, 1749: "Snow lay yet in several parts of the woods, especially where the trees stood very thick, and the sun could not make its way; however, it was not above four inches deep. All along the roads was ice, especially in the woods, and, therefore, it was very difficult to ride horses which were not sharp-shoed. The people who are settled here know little of sledges, but ride on horseback to church in winter, though the snow is sometimes near a foot deep. It lays seldom above a week before it melts, and then some fresh snow falls."*

While residing at *Raccoon*, a locality in Gloucester county, this traveler collected notes about the effects of severe cold upon trees and of late frosts in spring in killing blossoms and leaves. We extract the following:

"I often inquired among the old *Englishmen* and *Swedes* whether they had found that any trees were killed in very severe winters, or

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Edmunds' patent, called New Albion, which lieth just between New England and Maryland, and that ocean sea, I take it to be about 160 miles."—*Smith's History of New Jersey, pp.* 27, 28.

*"Travels into North America," by Peter Kalm, London, 1771, Vol. II., p. 73.

had received much hurt. I was answered that young hickory trees are commonly killed in very cold weather, and the young black oaks likewise suffer in the same manner. Nay, sometimes black oaks five inches in diameter were killed by the frost in a severe winter, and sometimes, though very seldom, a single mulberry tree was killed. Peach trees very frequently die in a cold winter, and often all the peach trees in a whole district are killed by a severe frost. It has been found repeatedly, with regard to these trees, that they can stand the frost much better on hills than in valleys; insomuch that when the trees in a valley were killed by frost, those on a hill were not hurt at all. They assured me that they had never observed that the black walnut tree, the sassafras, and other trees, had been hurt in winter. In regard to a frost in spring, they had observed at different times that a cold night or two happened often after the trees were furnished with pretty large leaves, and that by this most of the leaves were killed. But the leaves thus killed have always been supplied by fresh ones. It is remarkable that in such cold nights the frost acts chiefly upon the more delicate trees, and in such a manner that all the leaves, to the height of seven and even of ten feet from the ground, were killed by the frost, and all the top remained unhurt. Several old *Swedes* and *Englishmen* assured me they had made this observation, and the attentive engineer, Mr. Lewis Evans, has shown it me among his notes. Such a cold night happened here in the year 1746, in the night, between the 14th and 15th of *June*, new style, attended with the same effect as appears from Mr. *Evans'* observations. The trees which were then in blossom, had lost both their leaves and their flowers in those parts which were nearest the ground; some time after they got fresh leaves, but no new flowers. Further, it is observable that the cold nights which happen in spring and summer never do any hurt to high grounds, damaging only the low and moist ones. They are likewise very perceptible in such places where limestone is to be met with, and though all the other parts of the country be not visited by such cold nights in a summer, yet those where limestone lies have commonly one or two every summer. Frequently the places where the limestone lies are situated on a high ground; but they suffer, notwithstanding their situation; whilst a little way off, in a lower ground, where no limestone is to be found, the effects of the cold nights are not felt. Mr. *Evans* was the first who made this observation, and I have had occasion at different times to see the truth of it on my travels, as I shall mention in the sequel. The young hickory trees have their leaves killed sooner than other trees in such a cold night, and the young oaks next; this has been observed by other people, and I have found it to be true in the years 1749 and 1750." *

The occurrence of a frost in June, having a like effect upon tender leaves of trees, has been referred to on another page.

* Kalm, Vol. II., pp. 83–85.

One of the most remarkable of his inquiries was in regard to the weather and its changes and the permanency of climate. The answers of that day were substantially what might be obtained now. We quote:

"The following account the old man gave me, in answer to my questions with regard to the weather and its changes; it was his opinion that the weather had always been pretty uniform ever since his childhood; that there happen as great storms at present as formerly; that the summers now are sometimes hotter, sometimes colder, than they were at that time; that the winters were often as cold and as long as formerly; and that still there often falls as great a quantity of snow as in former times. However, he thought that no cold winter came up to that which happened in the year 1697, and which is often mentioned in the almanacks of this country; and I have mentioned it in the preceding volume. For in that winter the river *Delaware* was so strongly covered with ice that the old man brought many waggons full of hay over it near *Christina*, and that it was passable in sledges even lower. No cattle, as far as he could recollect, were starved to death in cold winters, except in later years, such cattle as were lean, and had no stables to retire into. It commonly does not rain, neither more nor less, in summer than it did formerly, excepting that, during the last years, the summers have been more dry. Nor could the old *Swede* find a diminution of water in brooks, rivers and swamps. He allowed, as a very common and certain fact, that wherever you dig wells you meet with oyster shells in the ground.

"The winter came sooner formerly than it does now. Mr. *Isaac Norris*, a wealthy merchant, who has a considerable share in the government of *Pennsylvania*, confirmed this by a particular account. His father, one of the first *English* merchants in this country, observed, that in his younger years, the river Delaware was commonly covered with ice, about the middle of *November*, old style, so that the merchants were obliged to bring down their ships in great haste before that time, for fear of their being obliged to lie all winter. On the contrary, this river seldom freezes over at present, before the middle of *December*, old style.

"It snowed much more in winter, formerly, than it does now; but the weather in general was likewise more constant and uniform, and when the cold set in, it continued to the end of *February*, or till *March*, old style, when it commonly began to grow warm. At present it is warm, even the very next day after a severe cold, and sometimes the weather changes several times a day.

"Most of the old people here were of opinion, that spring came much later at present than formerly, and that it was now much colder in the latter end of *February* and the whole month of *May* than when they were young. Formerly the fields were as green, and

the air as warm, towards the end of *February*, as it is now in *March*, or in the beginning of *April*, old style. The *Swedes* at that time made use of this phrase, *Pask bitida, Pask sent, altid Gras*, that is, we have always grass at *Easter*, whether it be soon or late in the year. But perhaps we can account as follows, for the opinion which the people here have, that vegetation appeared formerly more forward than it does now. Formerly the cattle were not so numerous as now; however, the woods were full of grass and herbs, which, according to the testimony of all the old people here, grew to the height of a man. At present a great part of the annual grasses and plants have been entirely extirpated by the continual grazing of numbers of cattle. These annual grasses were probably green very early in the spring, and (being extirpated) might lead the people to believe, that everything came on sooner formerly than it does at present. It used to rain more abundantly than it does now; during the harvest especially the rains fell in such plenty that it was very difficult to bring home the hay and corn. Some of the last years had been extremely dry. However, a few people were of opinion that it rained as plentifully at present as formerly.

"All the people agreed that the weather was not by far so inconstant when they were young as it is now. For at present it happens at all times of the year, that when a day has been warm, the next is very cold, and *vice versa*. It frequently happens that the weather alters several times in one day, so that when it has been a pretty warm morning, the wind blows from northwest about ten o'clock and brings a cold air with it; yet a little after noon it may be warm again. My meteorological observations sufficiently confirm the reality of these sudden changes of weather, which are said to cause, in a great measure, the people to be more unhealthy at present than they were formerly.

"I likewise found everybody agree in asserting that the winter betwixt the autumn of the year 1697, and the spring of the year 1698, was the coldest and the severest which they ever felt." *

* Kalm, Vol. II., pp. 119, 120, and 127–130.

EXPLANATION OF TABLE OF TEMPERATURE.

The table of temperature has been modeled after those of Chas. A. Schott (of United States Coast Survey), as published in "Smithsonian Contributions to Knowledge," No. 277. It contains the name of station, geographical position, elevation, mean, maximum and minimum temperatures by months, mean temperatures by seasons, and for the year and length of period of observation.

The arrangement of the localities, or meteorological stations, is geographical, beginning with those furthest north and going southward. And they appear in groups, corresponding in general to the divisions of the State, designated as climatological provinces.

The geographical positions are given to the nearest minute of latitude and longitude. The longitude is that west of Greenwich.

The elevations are expressed in feet above mean tide level, so far as they could be ascertained from railroad surveys, and from the topographical maps of the Geological Survey.

The "Tables of Atmospheric Temperature" in "Smithsonian Contributions to Knowledge," furnish heights for several stations.

The temperature is given in columns arranged by months, by the year and by seasons. In the monthly columns, the first of each gives the maximum or highest temperature *observed for that month* during the period covered by the record. The second column gives the minimum or lowest observed temperature for the month. And the third gives the mean daily temperature. The range for any given month is, therefore, apparent in the difference between the maximum and the minimum temperatures, as shown in the first and second columns. The mean annual temperature is the mean obtained from the several mean monthly temperatures. Following this column for the mean, are three columns giving the maximum, the minimum and the range of temperature for the year. Then follow the mean temperatures for the four seasons, consisting of the calendar months as commonly placed in them. In the three columns headed "Series," the dates of commencement, of end and the length of the observing period are given. The length in most cases consists of the actual time covered by the record,* and it is not always the same as that

*The length of record of observation in some cases consists of the number of months and twelve-months observed, but not calendar years. Hence, in a few cases the months are unequally represented. But in all the longer series the dates give the length.

comprised between the dates of beginning and end. The names of observers, so far as obtainable, are given in the last column.

The authorities for the tables are Schott's "Tables of Atmospheric Temperature," in "Smithsonian Contributions to Knowledge," No. 277; copies of records furnished by the Smithsonian Institution; copies of the records of the United States Signal Service Stations, contributed by the Chief Signal Officer of the United States Army; "Army Meteorological Register," Washington, 1851 and 1856; annual reports of the Chief Signal Officer, 1870 to 1886, inclusive; the Monthly Weather Review issued from same office; New York Meteorology, *by F. B. Hough, First and Second Series;* the American Almanac, for 1861; and original data furnished by local observers. In the case of nearly all the existing stations the records have been submitted to the observers, and revised by them wherever necessary, to correspond with their original records of observations. The mean temperatures are believed to be as nearly correct as it is possible to make them. In the columns for maximum and minimum temperatures, the extremes do not in all cases correspond to the whole length of periods covered by the mean temperatures, as the data were not accessible. It is possible that they do not, therefore, in a few localities, represent the extremes or indicate so wide a range as may have been observed.

In order to a more accurate comparison, the records of mean temperature of Newark and of Morrisville, Pa., where the observing hours are not the ordinary ones, (7 A. M., 2 P. M. and 9 P. M.,) have been corrected to correspond with observations made at those hours.

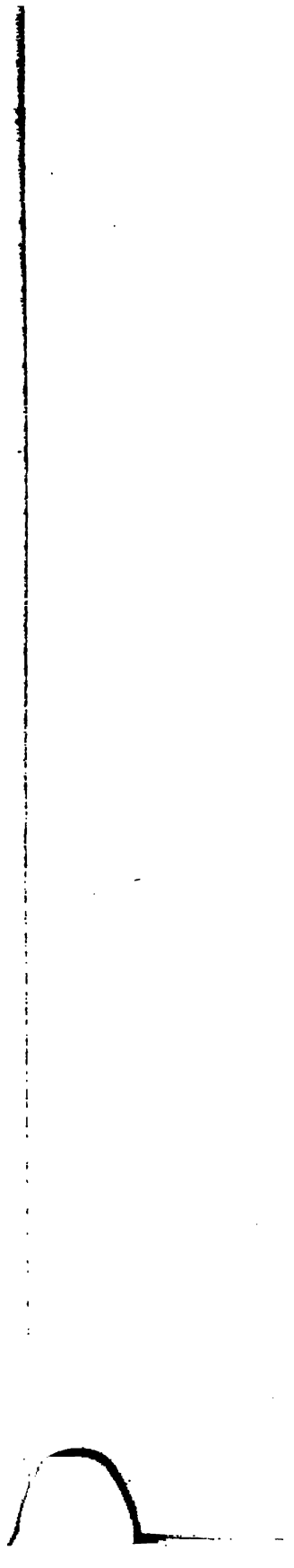
The temperatures are expressed in degrees and fractions of a degree, and according to the Fahrenheit scale.

Table of Extreme Temperatures in Degrees Fahrenheit.

STATIONS.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.		YEAR.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Goshen, N. Y.....	60	-30	60	-16	78	-5	84	10	89	26	96	36	96	42	91	36	88	32	82	14	78	4	62	-10	96	-30
Paterson.....	62	-14	65	-6	72	1	87	22	95	30	97	48	98	58	95	51	98	39	85	26	70	9	60	-2	98	-14
Newark.....	65	-12	68	-8	77	2	86	17	96	31	97	38	99.7	46	99	46.7	76	34	88	22	74	8	68.5	-6.5	99.7	-12.5
New Brunswick..	67	-12	67	-1	77	4	83	21	98	29	98	45	101	56	99	48	103	39	89	26	74	11	65	-12	103	-12
Lambertville.....	61	-20	67	-8.4	77	-0.7	85	14	93	29	100	38	101	44	97	40	97	32	88	20	75	10	70	-16.5	100	-20
Philadelphia, Pa.	67	-9	75	-2	79	5	88	17	96	31	98	42	101	50	99	50	101	37	88	17	80	10	72	-5	101	-9
Moorestown.....	69	-16	72	-5	79	2	86	22	97	36	99	45	102	58	98	46	103	37	90	22	78	10	71	-9	103	-16
Vineland.....	69	-11	75	-6	81	2	90	18	96	32	100	44	106	46	102	49	104	37	92	25	80	9	70	-10	104	-11
Greenwich.....	62	-9	67	2	76	7	82	25	87	40	94	50	95	55	93	53	89	42	79	29	73	17	67	1	95	-9
Atlantic City.....	64	-3	71	-5	72	8	84	19	89	33	95	45	99	53	92	49	94	40	83	29	72	10	64	-7	99	-7
Baltimore, Md.....	69	-15	78	-4	76	0	89	20	95	31	100	45	102	54	100	50	101	38	89	25	78	11	73	-3	102	-15
Extremes.....	69	-30	78	-16	81	-5	90	10	97	26	100	36	106	42	102	36	104	32	92	14	80	4	73	-16	101	-30

Table of Extreme Temperatures in Degrees Fahrenheit.

STATIONS.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.		YEAR.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Goshen, N. Y.....	60	-30	60	-16	78	-5	84	10	89	26	96	36	96	42	91	36	88	32	82	14	78	4	62	-10	96	-30
Paterson.....	62	-14	65	-6	72	1	87	22	95	30	97	48	98	58	95	51	98	39	85	26	70	9	60	-2	98	-14
Newark.....	65	-12	68	-8	77	2	86	17	96	31	97	38	99.7	46	99	46.7	76	34	83	22	74	8	68.5	-6.5	99 7	-12.5
New Brunswick..	67	-12	67	-1	77	4	83	21	98	29	98	45	101	56	99	48	103	39	89	26	74	11	65	-12	103	-12
Lambertville.....	61	-20	67	-8.4	77	-0.7	85	14	93	29	100	38	101	44	97	40	97	32	88	20	75	10	70	-16.5	100	-20
Philadelphia, Pa.	67	-9	75	-2	79	5	88	17	96	31	98	42	101	50	99	50	101	37	88	17	80	10	72	-5	101	-9
Moorestown.....	69	-16	72	-5	79	2	86	22	97	36	99	45	102	58	98	46	103	37	90	22	78	10	71	-9	103	-16
Vineland.....	69	-11	75	-6	81	2	90	18	96	32	100	44	106	46	102	49	104	37	92	25	80	9	70	-10	104	-11
Greenwich.....	62	-9	67	2	76	7	82	25	87	40	94	50	95	55	93	53	89	42	79	29	73	17	67	1	95	-9
Atlantic City.....	64	-3	71	-5	72	8	84	19	89	33	95	45	99	53	92	49	94	40	83	29	72	10	64	-7	99	-7
Baltimore, Md.....	69	-15	78	-4	76	0	89	20	95	31	100	45	102	54	100	50	101	38	89	25	78	11	73	-3	102	-15
Extremes.....	69	-30	78	-16	81	-5	90	10	97	26	100	36	106	42	102	36	104	32	92	14	80	4	73	-16	104	-30



EXPLANATION OF TABLE OF RAIN AND MELTED SNOW.

The second column gives the names of localities or stations. Their more exact location is given in the columns of latitude and longitude.* The elevations are expressed in feet, above mean tide level, and are from the topographical maps of the Geological Survey, and from railroad surveys.

The amount of rain and melted snow is given in inches and hundredths, and the figures stand for the mean or average quantities for each month of the year. Following them are the mean quantities for the several seasons, and, lastly, that for the year. The dates of commencement and end of the record, and the length, are next given. The last column has the observers' names, or other authority for the records.

The mean quantities for the months are obtained by adding together the quantities for the given months in the several years observed, and dividing by the number of years. Inasmuch as there are often gaps—months without any record—allowance is made for them. Consequently, the means at any given station may not represent any equal number of records for all the months of the year. The mean for any given month is the quotient of the total rainfall of that month throughout the period, divided by the number of months observed. The averages for the seasons are made by adding together the monthly averages belonging to the calendar months of the several seasons. Thus, spring covers the months of March, April and May. The annual fall is the sum of the months, or that of the four seasons.†

The length of the period includes the actual number of years (or twelve-months) and months observed, and is not, in many cases, coincident with the length of time between the dates of beginning and end, as they appear in the preceding columns. But in all the longer series there are no gaps. The records for short periods are of much less importance, and hence omissions in them of single months are of less account.

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* The longitudes are west from Greenwich.

† Slight discrepancies between the sum of months or seasons and the year, in the case of two stations, are owing to differences in the yearly means as furnished by observers.

Table of Rain and Melted Snow. Inches and Hundredths of Inches.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October	November.	December.	
1	White Plains, Westchester Co., N. Y.	42° 02′	73° 40′	200	6.09	5.63	4.21	3.84	3.34	4.62	4.87	3.74	3.03	3.58	3 25	4.79	1
2	West Point, Orange Co , N. Y.	41° 24′	73° 57′	167	3.86	3.47	3.32	3 89	4.79	3.58	4.42	4.88	3.42	4.32	4.11	4.10	2
3	Goshen, Orange Co., N. Y.	41° 23′	74° 20′	425	2.59	2.55	2.61	2.05	3.44	3.27	2.95	2.66	2.79	3.13	2.34	3.44	3
4	Port Jervis, Orange Co., N. Y.	41° 22′	74° 42′	450	3.53	3.61	3.30	3.09	3.43	3.69	4 68	3.02	3.12	2.60	2.29	2.82	4
5	Deckertown, Sussex Co.	41° 12′	74° 36′	470	1.94	2.41	2.86	2.16	2.73	.....	.....	2.92	2.47	.....	.....	.....	5
6	Newton, Sussex Co.	41° 03′	74° 45′	659	4.05	1.88	4.89	1.79	3.57	3.49	1.92	.....	.....	.....	.....	2.45	6
7	Dodge Mine, Morris Co.	41° 01′	74° 35′	1,160	3.01	2.57	4.68	2.31	0.99	4.12	7.22	4.75	2 70	2.54	2.04	1.47	7
8	Lake Hopatcong, Morris Co.	40° 55′	74° 39′	914	2.37	2.44	2.79	3.47	4.67	3.66	3.95	4.31	3.98	3.77	3.67	3.46	8
9	Dover, Morris Co.	40° 53′	74° 34′	580	4.61	3.22	2.44	2.86	5.45	5.47	5.62	5.81	2.90	3.12	3.45	4.18	9
10	Belvidere, Warren Co.	40° 50′	75° 05′	280	4.49	4.78	.....	2.36	.....	.....	6.12	5.90	1.21	5.07	1.55	3.03	10
11	Phillipsburg, Warren Co.	40° 41′	75° 11′	220	4.00	3.95	3.12	2.15	4.07	3.29	3.76	3.69	3.66	2.63	1.81	2.70	11
12	New York City, N. Y.	40° 42½′	74° 00′	164	3.71	3.73	3.96	3.29	2.82	3.51	4.49	4.77	3.21	3.29	3.48	3.34	12
13	Fort Columbus, New York Harbor.	40° 42′	74° 01′	20	3.29	3.23	3.34	3.16	4.31	3.92	3.62	4.48	3.39	3.30	3.27	4.03	13
14	Jersey City, Hudson Co.	40° 43′	74° 03′	20	3.16	3.00	4.53	4.10	2.71	3.14	5.11	5.45	3.61	2.99	3.77	2.65	14
15	Tenafly, Bergen Co.	40° 55′	73° 58′	100	2.61	3.11	3.86	0.91	.....	9.57	4.86	5.50	2.22	2.87	2.06	3.64	15
16	Paterson, Passaic Co.	40° 55′	74° 10′	60	4.17	4.83	5.51	3.06	5.01	5.59	6.15	4.16	5.57	2.98	3.06	4.96	16
17	Upper Montclair, Essex Co.	40° 51′	74° 13′	340	2.96	.....	.....	.....	6.20	5.17	5.27	2.59	1.33	3.40	4.38	1.62	17
18	Bloomfield, Essex Co.	40° 48′	74° 12′	120	3.39	2.99	2.68	4.05	4.61	3.64	4 19	4.54	2.41	3.30	3.47	3.11	18
19	Newark, Essex Co.	40° 44′	74° 10′	35	3.65	3.60	3.81	3.53	3.97	3.57	4.28	5.07	3.75	3.58	3.63	3.81	19

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
20	East Orange, Essex Co	40° 46′	74° 12′	160	2.65	2.17	4.08	4.56	2.47	3.43	4.62	5.61	2.22	5.05	5.77	4.33	20
21	Orange, Essex Co	40° 47′	74° 13′	185	1.10	2.55	3.55	5.12	2.98	3.45	6.70	5.43	5.50	3.70	3.27	3 13	21
22	South Orange, Essex Co	40° 45′	74° 15′	140	3.96	3.72	3.68	2.91	2 82	3.35	4.72	5.05	3.42	3.39	3.28	3 81	22
23	Elizabeth, Union Co	40° 40′	74° 13′	30	.....	4.48	3.56	2.89	0.53	6.60	7.71	2.79	2.87	2.79	2.11	2.81	23
24	Union, Union Co	40° 41′	74° 16′	110	6.35	5.03	3.27	2.47	0.97	6.87	9.29	2.60	2.56	2.47	1.92	3.64	24
25	Linden, Union Co	40° 38′	74° 15′	30	4.47	2 85	4.70	2.46	2.31	2.78	5.10	5.35	3.09	2.81	4.47	3.45	25
26	Pequanac, Morris Co	40° 57′	74° 17′	170	.....	.....	.....	.....	.....	.....	3.14	1.38	12.39	.....	.....	.....	26
27	Caldwell, Essex Co	40° 50′	74° 17′	420	5.54	4.89	4.65	4.29	3.87	6.36	4.49	4.14	5.56	5.23	1.30	3.54	27
28	Gillette, Union Co	40° 41′	74° 28′	220	.....	.....	.....	.....	.....	.....	.....	2.98	1.62	.....	0.95	5.36	28
29	New Germantown, Hunterdon Co	40° 40′	74° 45′	260	3.08	2.78	3.76	3.24	3.29	4.03	4.71	4.95	3.13	5.01	3.67	2.44	29
30	Readington, Hunterdon Co	40° 34′	74° 44′	110	3.62	4.30	3.01	4 65	3.85	3.95	5.67	5.63	4.20	4.77	3.54	4.63	30
31	Ringoes, Hunterdon Co	40° 26′	74° 52′	248	2.52	2.84	5.34	2.71	2.10	3.87	5.80	5.24	4.14	3.32	3.97	3.93	31
32	Somerville, Somerset Co	40° 34′	74° 36′	65	3.91	3.77	3.96	2.57	2.59	4.77	5.67	4.43	1.77	3.19	3.25	4.74	32
33	New Brunswick, Middlesex Co	40° 29′	74° 27′	90	3.07	2.97	3.38	3.78	3.82	3.89	4.63	4.94	3.39	3.33	3.64	3.47	33
34	Princeton, Mercer Co	40° 21′	74° 40′	220	4.05	4.06	3.74	2.96	2.59	2.06	6.27	2.98	1.97	2.26	2.59	4.24	34
35	Locktown, Hunterdon Co	40° 29′	74° 59′	490	3.82	6.16	3.06	2.08	1.99	7.78	7.86	5.37	3.04	2 23	1.32	6.01	35
36	Lambertville, Hunterdon Co	40° 22′	74° 57′	96	3.22	3.12	3.25	3.16	4.12	3.76	4.26	4.83	3.68	3.33	3.11	4.08	36
37	Trenton, Mercer Co	40° 13′	74° 46′	50	3.25	2.59	3.87	3.86	3.10	4.01	5.61	5.39	3.61	3.67	4.43	3.11	37
38	Morrisville, Bucks Co., Penna	40° 13′	74° 47′	30	3.29	2.77	3.33	3.87	3.94	4.09	3.62	4.05	3.48	3.65	4.28	3.29	38

Table of Rain and Melted Snow. Inches and Hundredth of Inches—Continued.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
39	Fallsington, Bucks Co., Penna	40° 12′	74° 48′	30	4 29	4.90	3.07	2.60	3.52	3.65	3.74	4.41	3.27	2.92	2.91	3.57	39
40	Sandy Hook, Monmouth Co	40° 28′	74° 01′	30	4.33	3.82	5.01	4.43	4.32	4.09	4.41	4.61	4.09	3.66	4.27	4.04	40
41	Riceville, Monmouth Co	40° 24′	74° 02′	30	5.68	2 32	3.61	4.52	5.74	2 00	1.65	2.61	.....	.....	.....	.....	41
42	Middletown, Monmouth Co	40° 24′	74° 07′	120	5.72	2.55	1.16	2.50	4.50	4.10	3.40	1.70	2 50	4.00	3.13	1.37	42
43	Oceanic, Monmouth Co	40° 23′	74° 01′	20	.....	1.13	4.64	3.35	0.85	7.67	6.95	5.15	3.75	3.90	2.54	5.43	43
44	Long Branch, Monmouth Co	40° 18′	73° 59′	28	3.59	3.76	5.71	6.48	3.34	3.28	5.30	7.07	7.52	3.28	5.32	3.68	44
45	Lakewood, Ocean Co	40° 05′	74° 13′	50	.....	4.57	3.89	3.57	1.44	.....	.....	.....	.....	.....	2.14	.....	45
46	Toms River, Ocean Co	39° 57′	74° 12′	20	.....	.....	.....	.....	.....	.....	.....	.....	5.93	3.14	2.18	4.18	46
47	Squan Beach, Ocean Co	40° 08′	74° 01′	23	3.71	3.03	4 79	8.31	2.98	3.76	4.39	6.20	8.31	2.73	5.50	3.88	47
48	Matawan, Monmouth Co	40° 25′	74° 14′	50	2.00	4 65	2.77	2.12	0.08	6.47	14.00	3.34	3.18	2.43	1.55	4.25	48
49	Freehold, Monmouth Co	40° 15′	74° 17′	190	3.97	3.75	4.97	3.41	2.78	3.91	3.92	5.02	4.48	3.06	3.69	3.77	49
50	Imlaystown, Monmouth Co	40° 10′	74° 31′	110	3.28	6.45	3.22	2.90	1.17	8.19	6.81	2.12	4.92	2.68	1.74	6.00	50
51	Hightstown, Mercer Co	40° 16′	74° 32′	100	1.58	4.91	5.77	2.73	2.91	.....	.....	.....	.....	0.90	5.38	.....	51
52	Bordentown, Burlington Co	40° 09′	74° 43′	60	4 21	5.19	2.92	3.09	1.87	8.15	7.90	2.09	8.35	1.86	1.88	4.32	52
53	Burlington, Burlington Co	40° 05′	74° 51′	20	3.26	3.57	3.49	3.83	5.86	5.04	3.51	5.31	3.47	3.36	2.86	4 32	53
54	Beverly, Burlington Co	40° 04′	74° 55′	30	3.25	4.78	3.44	4.04	4.79	4.73	7.51	2.51	3.28	2.64	2.85	4.18	54
55	Philadelphia, Penna	39° 56′	74° 10′	36	3.29	3.08	3.42	3.47	3.73	3.96	4.03	4.47	3.57	3.21	3.37	3.43	55
56	Mount Holly, Burlington Co	40° 00′	74° 47′	30	1.34	3.60	2.69	2.73	2.29	3.25	3.49	7.11	3.69	1.55	3.93	3.07	56
57	Moorestown, Burlington Co	39° 58′	74° 57′	104	3.44	3.50	3 39	2.92	3.77	3.93	4.18	4.43	3.82	3.18	3.25	3.42	57

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
58	Haddonfield, Camden Co...	39° 53′	75° 02′	50	3.13	2.92	4.17	3.38	6.20	3.57	2.79	4.97	4.59	3.55	3.39	4.04	58
59	Atco, Camden Co	39° 46′	74° 53′	150	3.73	3.36	4.25	2.85	2.93	4.15	4.07	5.87	4.76	2.96	3.93	3.90	59
60	Harrisville, Burlington Co	39° 40′	74° 31′	20	.....	4.69	3 68	3.20	1.15	6.79	3.73	5.19	5.10	2.70	2.39	.....	60
61	Egg Harbor City, Atlantic Co	39° 32′	74° 38′	40	.....	.....	4.50	9.20	15.07	5.79	7.95	5.36	1.25	3.15	3.37	3.39	61
62	Clayton, Gloucester Co....	39° 39′	75° 05′	130	3.84	6.47	2.98	2.69	2.99	4.97	3.77	3.06	3.40	2.29	3.52	4.30	62
63	Vineland, Cumberland Co	39° 29′	75° 01′	120	4.60	4.06	4.43	3.12	3.76	3.52	4.25	5.09	4.38	3.33	3.72	4.01	63
64	Barnegat, Ocean Co	39° 46′	74° 07′	20	4.93	3.52	4.66	3.56	2.54	3.51	3.86	4.97	4.74	3.50	4.28	4.24	64
65	Little Egg Harbor, Burlington Co	39° 30′	74° 17′	14	4.95	5.48	3.67	2.86	1.38	2.14	2.75	7.69	5.48	3.52	1.74	2.75	65
66	Atlantic City, Atlantic Co	39° 22′	74° 25′	14	3 91	3.51	3.77	3.33	2 46	3.20	3.27	4.82	3.15	3.24	3.62	4.33	66
67	Peeks Beach, Cape May Co	39° 11′	74° 40′	20	3 54	3 99	4.13	7.17	1.72	2 66	2 21	3.79	6.26	1.24	4.01	4.86	67
68	Ocean City, Cape May Co	39° 17′	74° 34′	20	.....	5.25	.....	.....	.....	.....	.....	2.10	3.80	5.00	2.00	5.50	68
69	Cape May, Cape May Co	38° 56′	74° 58′	28	4.37	3.79	4.97	3.16	2.71	3.50	3.28	6.08	4.13	3.26	3.51	4.34	69
70	Salem, Salem Co	39° 35′	75° 28′	15	4.51	.....	1 00	2.96	2.34	3.25	3.15	6.28	3.11	1 93	2.22	2.85	70
71	Allowaystown, Salem Co	39° 31′	75° 22′	20	3.61	3.52	2.65	2.43	2.97	3.27	2.76	8.98	3.36	3.73	3.93	4.00	71
72	Greenwich, Cumberland Co	39° 23′	75° 20′	15	2.97	3.86	4.28	2.51	4.74	3.17	2.81	4.29	4.06	2.95	3.25	2.64	72
73	Dover, Kent Co., Del	39° 10′	75° 30′	40	2 66	3.15	4.94	2.99	2 82	3.24	5.04	4.95	4.39	2.78	3.98	3.01	73
74	Baltimore and Fort McHenry	39° 16′	76° 35′	36	2 95	2.98	3.79	3.33	3.55	3.59	3.81	4.34	3.41	3.18	3.33	3.72	74

For Observers, see pages 396–399.

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS.				Year.	SERIES.				OBSERVERS.	
		Spring.	Summer.	Autumn.	Winter.		Beginning.	End.	Length. Yrs.	Length. Mos.		
1	White Plains, Westchester Co., N. Y...	11.39	13.23	9.86	16.51	50.99	—., 1873	Dec., 1887	14	4	Prof. O. R. Willis	1
2	West Point, Orange Co., N. Y.	12.00	12 88	11.85	11.43	48.16	Jan., 1840	Dec., 1887	25	2	United States Military Post	2
3	Goshen, Orange Co., N. Y..	8.10	8.88	8.26	8.58	33.82	Jan., 1835	Dec., 1849	8	.....	New York University System	3
4	Port Jervis, Orange Co , N. Y.	9.82	11.39	8.01	9.96	39.18	Jan., 1880	Dec., 1884	5	.....	Charles F. Van Inwegen	4
5	Deckertown, Sussex Co	7.75	.....	.....	.....	.....	Jan., 1880	Sept., 1880	.....	7	A. C. Noble	5
6	Newton, Sussex Co	10.25	.....	.....	8.38	.....	Dec., 1868	July, 1869	.....	8	Dr. Thomas Ryerson	6
7	Dodge Mine, Morris Co	7.98	16.09	7.28	7.05	38.40	Jan., 1880	June, 1881	1	6	Wm. Allen Smith	7
8	Lake Hopatcong, Morris Co	10.93	11.93	11.42	8.26	42.54	Jan., 1846	Dec., 1869	24	.....	{Morris Canal Co., W. H. Talcott, Engineer}	8
9	Dover, Morris Co	10.25	16.90	9.47	12.01	48.63	Nov., 1866	Dec., 1887	5	2	H. Shriver, W. Harris	9
10	Belvidere, Warren Co	.....	.....	7.83	12.30	.....	Oct., 1883	Oct., 1884	.....	10	.....	10
11	Phillipsburg, Warren Co	9.34	10.74	8.10	10.65	38.83	Jan., 1881	Aug., 1886	3	8	Jos. C. Kent	11
12	New York City, N. Y.	10.07	12.77	9.98	10.78	43.60	Jan., 1871	Dec., 1887	17	.....	United States Signal Station	12
13	Fort Columbus, New York Harbor	10.81	12.02	9.96	10.55	43.34	Jan., 1836	Dec., 1887	30	4	United States Military Post	13
14	Jersey City, Hudson Co	11.34	13.70	10.37	8.81	44.20	Mar., 1871	Nov., 1877	6	.....	Thomas T. Howard, Jr.	14
15	Tenafly, Bergen Co	.....	19.93	7.15	9.36	.....	Jan., 1887	Dec., 1887	.....	11	A. D. Atwood	15
16	Paterson, Passaic Co	13.58	15.90	11.61	13.96	55.05	Jan , 1878	Dec , 1887	8	9	W. Aug. Fonda, J. T. Hilton	16
17	Upper Montclair, Essex Co	.....	13 03	9.11	.....	.....	Jan., 1887	Dec., 1887	.....	9	F. L. Van Gieson	17
18	Bloomfield, Essex Co	11 34	12.37	9.18	9 49	42.38	Mar., 1849	Dec., 1862	10	4	R. L. Cooke	18
19	Newark, Essex Co	11.31	12.92	10.96	11.06	45.95	May, 1843	Dec., 1887	44	8	Fred'k W. Ricord	19

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS.				Year.	SERIES.				OBSERVERS.	
		Spring.	Summer.	Autumn.	Winter.		Beginning	End.	Length. Yrs.	Mos.		
20	East Orange, Essex Co.	11.11	13.66	13.04	9.15	46.96	June, 1877	Sept., 1879	1	10	Thomas T. Howard, Jr.	20
21	Orange, Essex Co	11.65	15.58	12.47	6.78	46.48	Jan , 1872	Dec., 1874	2	8	Dr. W. H. Stockwell	21
22	South Orange, Essex Co.	9.41	13.12	10.09	14.49	44.11	Sept., 1870	Dec., 1887	17	3	Dr. Wm. J. Chandler	22
23	Elizabeth, Union Co.	6.98	17.10	7.77	.....	.....	Feb., 1887	Dec., 1887	.....	11	N. S. Wilson, M.D.	23
24	Union, Union Co	6.71	18.76	6.95	15.02	47.44	Jan., 1887	Dec., 1887	1	.....	T. L Dunbar	24
25	Linden, Union Co.	9.41	13.23	10.37	10.77	43.78	Sept., 1876	April, 1881	4	8	Arthur B. Noll.	25
26	Pequanac, Morris Co.	.....	.....	.....	.....	.....	July, 1882	Sept., 1882	.....	3	.....	26
27	Caldwell, Essex Co.	12.81	14.99	12.09	13 97	53.86	Feb., 1883	Aug., 1884	1	6	Marcus Harrison	27
28	Gillette, Union Co.	.....	.....	.....	.....	.....	Aug., 1887	Dec., 1887	.....	4	R. N. Cornish	28
29	New Germantown, Hunterdon Co.	10.29	13.69	11.81	8.30	44.09	Nov., 1868	Aug., 1876	7	10	Arthur B. Noll.	29
30	Readington, Hunterdon Co.	11.51	15.25	12.51	12.55	53.82	Dec., 1866	Dec., 1885	1	9	John Fleming and W. T. Kerr	30
31	Ringoes, Hunterdon Co.	10.15	14.91	11.40	9.29	45.75	Jan., 1876	Dec., 1880	5	.....	Prof. C. W. Larison	31
32	Somerville, Somerset Co.	9.12	14.87	8 21	12.42	44.62	Sept., 1878	Dec., 1887	7	7	Wm. J. Morgan	32
33	New Brunswick, Middlesex Co.	10.98	13.46	10 36	9.51	44.31	Jan., 1854	Dec., 1887	34	.....	P. V. Spader, Dr. Geo. H. Cook, E. W. McGann	33
34	Princeton, Mercer Co.	9.29	11.31	6.82	12.35	39.77	Sept., 1878	Dec., 1887	4	.....	Profs. Chas. G. Rockwood and M. M. McNeil	34
35	Locktown, Hunterdon Co.	7.13	21.01	6 59	15.99	50.72	Jan., 1887	Dec., 1887	1	.....	G. W. Hockenbury	35
36	Lambertville, Hunterdon Co.	10.53	12.85	10.12	10.42	53.92	July, 1843	Dec., 1887	18	.....	L. H. Parsons	36
37	Trenton, Mercer Co.	10.83	15.01	11.71	8.95	47.55	Jan., 1866	Dec., 1880	15	.....	E. R. Cook	37
38	Morrisville, Bucks Co., Penna.	11.14	11.76	11.41	9.35	43.66	Oct., 1798	Dec., 1866	45	1	Ch. Pierce and E. Hance	38

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS.				Year.	SERIES.				OBSERVERS.	
		Spring.	Summer.	Autumn.	Winter.		Beginning.	End.	Length. Yrs.	Length. Mos.		
39	Fallsington, Bucks Co	9.19	11.80	9 10	12.76	42.85	Jan., 1881	Dec., 1887	6	6	E. Hance	39
40	Sandy Hook, Monmouth Co	13.76	13.11	12.02	12.19	51.08	Jan., 1874	Nov., 1886	12	11	United States Signal Station	40
41	Riceville, Monmouth Co	13.87	6.26	.....	.....	.....	Jan., 1861	Aug., 1861	.....	8	Prof. L. Harper	41
42	Middletown, Monmouth Co	8.16	9.20	9 63	9.64	36.63	June, 1831	May, 1832	1	.....	From Smithsonian Coll	42
43	Oceanic, Monmouth Co	8.84	19.77	10.19	.....	45.36	Feb., 1887	Dec., 1887	.....	11	Rev. S. W. Knipe	43
44	Long Branch, Monmouth Co	15.53	15.65	16.12	11.03	58.32	Jan., 1874	June, 1876	2	6	United States Signal Station	44
45	Lakewood, Ocean Co	.....	.....	.....	.....	.....	Feb., 1887	Nov., 1887	.....	5	Dr. W. C. Stone	45
46	Toms River, Ocean Co	.....	.....	.....	.....	.....	Sept., 1887	Dec., 1887	.....	4	J. P. Haines	46
47	Squan Beach, Ocean Co	16.08	14.35	16.54	10.62	57.59	Jan , 1874	Jan., 1876	2	1	United States Signal Station	47
48	Matawan, Monmouth Co	4.97	23.81	7.16	10.90	46.84	Jan., 1887	Dec., 1887	1	.....	Prof. J. C. Rice	48
49	Freehold, Monmouth Co	11.16	12.85	11.23	11 49	46 73	Apr., 1874	Dec., 1883	9	7	Prof Chas. F. Richardson	49
50	Imlaystown, Monmouth Co	7.29	17.12	9 34	15.73	49.48	Jan., 1887	Dec., 1887	1	.....	Dr. H. G. Norton	50
51	Hightstown, Mercer Co	11.31	.....	.....	.....	.....	Jan , 1876	Oct., 1876	.....	7	Peddie Institute	51
52	Bordentown, Burlington Co	7.88	18.14	12.09	13.72	51.83	Sept., 1882	Dec., 1887	1	9	M. S. Simpson, M.D	52
53	Burlington, Burlington Co	13.18	13.86	9.69	11.15	47.88	July, 1856	Mar., 1868	5	10	Dr. E. R. Schmidt, Rev. A. Frost, T. C. Deacon	53
54	Beverly, Burlington Co	12.27	14.75	8.77	12.21	48.00	Jan., 1886	Dec., 1887	2	.....	Charles H. Richardson	54
55	Philadelphia, Penna	10.62	12.46	10.15	9.80	43.03	Jan., 1825	Dec., 1887	63	.....	United States Signal Station, Obs. Penn. Hospital	55
56	Mount Holly, Burlington Co	7.71	13.85	9.17	8.01	38.74	Sept., 1874	June, 1876	1	9	Dr. F. Ashhurst	56
57	Moorestown, Burlington Co	10.08	12.54	10.25	10 36	43.23	May, 1863	Dec., 1887	24	4	Thomas J. Beans	57

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS.				Year.	SERIES.				OBSERVERS.	
		Spring.	Summer.	Autumn.	Winter.		Beginning.	End.	Length. Yrs.	Length. Mos.		
58	Haddonfield, Camden Co	13.75	11.33	11.53	10.09	46.70	Feb., 1864	Dec., 1870	6	6	J. S. Lippincott, S. Wood, J. Boadle	58
59	Atco, Camden Co	10.03	14.09	11.65	10.99	46.76	Jan , 1872	Sept., 1882	10	5	H. A. Green	59
60	Harrisville, Burlington Co	8.03	15.71	10.19	.....	.....	Feb., 1887	Nov., 1887	.....	10	J. W. Harris	60
61	Egg Harbor City, Atlantic Co	28.77	19.10	7.77	.....	.....	Mar., 1886	Dec., 1886	.....	10		61
62	Clayton, Gloucester Co	8.66	11.80	9.21	14.61	44.28	Jan., 1886	Dec., 1887	2	.....	Wm T. Wilson	62
63	Vineland, Cumberland Co	11.31	12.86	11.43	12.67	48.27	Jan., 1866	Dec., 1886	21	.....	Dr. O. H. Adams, Dr. J. Ingram	63
64	Barnegat, Ocean Co	10.76	12.34	12.52	12.69	48.31	Jan , 1874	Dec., 1885	12	.....	United States Signal Station	64
65	Little Egg Harbor, Burlington Co	7.91	12.58	10.74	13.18	44.41	July, 1882	June, 1884	2	.....	United States Signal Station	65
66	Atlantic City, Atlantic Co	9.56	11.22	10.02	11.75	42.55	Jan , 1874	Dec., 1887	14	.....	United States Signal Station	66
67	Pecks Beach, Cape May Co	13.02	8.66	11.51	12.39	45.58	Jan., 1874	Jan., 1876	2	1	United States Signal Station	67
68	Ocean City, Cape May Co	.....	.....	10.80.	.....	.....	Feb., 1887	Dec., 1887	.....	6	William Lake	68
69	Cape May, Cape May Co	10.84	12.86	10.90	12.50	47.10	Sept , 1871	Oct., 1885	13	8	United States Signal Station	69
70	Salem, Salem Co	6.30	12.68	7.26	.....	.....	May, 1877	Dec., 1887	1	11	W. B. Mattaock, S. L Richmond	70
71	Allowaystown, Salem Co	8.05	15.01	13.02	11.13	47.21	Jan., 1872	Nov., 1873	1	11	H. C. Perry	71
72	Greenwich, Cumberland Co	11.53	10.27	10.26	9.47	41.53	Mar., 1864	Feb., 1873	9	.....	Rebecca C. Sheppard	72
73	Dover, Kent Co., Del	10.75	13.23	11.15	8.82	43.95	July, 1870	Jan., 1881	9	9	J. H. Bateman	73
74	Baltimore, and Fort McHenry	10.67	11.74	9.92	9.65	41.98	May, 1836	Dec., 1887	51	8	United States Signal Station. United States Military Post	74

Climate of Newark, 1843-1887.

From Records kept by Wm. A. Whitehead and Frederick W. Ricord.

	Maximum Temperature.		Minimum Temperature.		Range of Temperature for Period.	Mean Temperature.		Greatest Number of Days on which Temperature was 32° and below.	Greatest Number of Days on which Temperature was 85° and upwards.	Range of Fair Days		Rainy Days.		Days of Snow.		Average Number of Fair Days.	Percentage of Fair Days.	Range of Dry Periods. Days.	
	Highest.	Lowest.	Highest.	Lowest.		Highest.	Lowest.			Greatest Number.	Least Number.	Greatest Number.	Least Number.	Greatest Number.	Least Number.			Longest.	Shortest.
January	65.00	30.60	16.00	-12.70	77.70	37.64	19.33	22	.....	21	13	11	1	12	1	17.00	55	15	5
February	68.50	44.70	16.00	-8.00	76.50	36.99	21.86	18	.....	21	12	11	1	13	2	16.50	58	14	4
March	77.25	50.00	28.00	2.00	75.25	46.17	30.23	7	.....	23	13	16	2	11	1	18.00	58	16	5
April	86.00	62.25	40.00	17.00	69.00	55.55	40.30	.....	.....	23	12	13	5	9	.....	17.50	58	15	3
May	96.00	71.00	42.50	31.00	65.00	68.38	54.72	.....	8	25	12	17	5	2	.....	18.70	60	14	4
June	97.00	84.00	57.50	38.25	58.75	73.70	60.25	.....	11	26	15	15	5	.....	.....	20.50	68	20	3
July	99.75	86.25	66.00	46.25	53.50	79.60	70.23	.....	24	25	14	15	4	....	...	19.75	64	15	6
August	99.00	83.75	60.00	46.75	52.25	76.60	67.30	.....	20	26	14	15	5	....	.....	19.75	64	20	5
September	100.50	76.50	50.70	34.50	66.00	73.72	59.98	.....	11	24	12	14	3	.....	.....	18.75	62	21	3
October	83.00	67.00	36.00	22.25	60.75	59.40	48.61	6	.....	24	12	12	3	2	.....	18.00	58	29	3
November	73.75	57.25	29.00	8.00	65.75	49.66	36.12	21	.....	22	10	15	4	10	....	16.00	53	18	3
December	68.50	42.00	22.75	-7.50	76.00	40.31	23.81	28	.....	24	11	13	2	10	1	17.00	55	24	3
Spring	.....	.....	.....	.....	.....	53.81	45.13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Summer	.....	.....	.....	.....	.....	75.34	68.12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Autumn	.....	.....	.....	.....	.....	58.77	50.77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winter	.....	.....	.....	.....	.....	35.91	24.81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Climate of Cape May, N. J.

PERIOD OF OBSERVATION, JUNE 1ST, 1871, TO DECEMBER, 1883. DEGREES FAHRENHEIT.

[Taken from Dr. Huntington Richards' Article on Cape May, in "Wood's Hand-book of Reference to the Medical Sciences."]

	A. Mean Temperature of Months at the Hours of—			AA.	B.		C.	D.	E.		F.		G.	H.	J.	K.	N.	O.	R.	S.
	7 A. M.	2 P. M.	11 P. M.	Average Mean Temperature Deduced from Column A.	Mean Temperature for Period of Observation. Highest.	Mean Temperature for Period of Observation. Lowest.	Average Maximum Temperature for Period.	Average Minimum Temperature for Period.	Absolute Maximum Temperature for Period. Highest.	Absolute Maximum Temperature for Period. Lowest.	Absolute Minimum Temperature for Period. Highest.	Absolute Minimum Temperature for Period. Lowest.	Greatest Number of Days in any Single Month on which the Temperature was Below 32°.	Greatest Number of Days in any Single Month on which the Temperature was Above 90°.	Range of Temperature for Period.	Mean Relative Humidity.	Average Number of Fair and Clear Days.	Average Rainfall, in Inches.	Prevailing Direction of Wind. From	Average Velocity of Wind, in Miles, per Hour.
January. ...	31.9	36.6	34.1	34.2	43.2	28.6	41.2	29.4	58	43	18	1	26	0	57	78.2	20.0	4.22	N.W.	14.3
February....	33.1	38.6	35.3	35 6	41.7	28.0	45.0	31.8	59	42	23	2	22	0	57	76.7	18.2	3.60	N.W.	16 1
March.....	37.9	42.9	39.6	40.1	47.7	33.3	47.7	35.1	65	48	25	9	16	0	56	74.9	19.2	5.14	N.W.	16.4
April	45.9	51.2	47.2	48.1	54.7	44.0	54.8	43.0	76	59	43	24	5	0	54	74.2	19.5	3.34	N.W.	14.6
May	56.7	62.1	57.1	58.6	65.2	55.1	65.8	53.7	81	72	48	34	0	0	47	76.7	23.2	2.62	S.	12.5
June.....	66.8	71.6	66.6	68.3	71.2	64.8	74.3	63.2	89	79	60	47	0	0	42	79.5	22.1	3.81	S.	10.8
July	72.1	77.2	71.6	73.6	75.6	69.5	80.0	69.3	91	79	70	56	0	1	35	79.7	23.7	3.30	S.	10.0
August.....	71.6	76.3	71.5	73.1	76.6	68.7	78.5	67.5	88	80	64	55	0	0	33	80.3	21.5	5.77	S.	9.8
September	65.8	71.3	66.7	67.9	74.5	63.8	75.3	64.6	87	75	55	42	0	0	45	76.8	21.4	4.46	E.	11.7
October.....	56.5	62.1	57.9	58.8	64.3	55.2	66.2	51.2	81	67	48	31	0	0	50	75.1	22.7	3,53	N.W.	13.6
November.	44.2	48 9	45.5	46.2	51.6	41.9	54.1	41.8	69	55	30	14	10	0	55	72.5	18.3	3.73	N.W.	15.7
December ..	35.4	39.5	37.3	37.4	43.9	31.1	44.0	32.1	62	43	26	2	27	0	60	75.7	18.9	4.15	N.W.	15.9
Spring.....	.....	.....	.....	48.9	54.2	45.6	.....	.....	.....	.....	.....	.....	.....	.....	72	75.3	61.9	11.10	N.W.	14.5
Summer.....	.....	.....	.....	71.6	74 2	68.8	.....	.....	.....	.....	.....	.....	.....	.....	44	79.8	67.3	12.88	S.	10.2
Autumn.....	.....	.....	.....	57.6	62.9	54.2	.....	.....	.....	.....	.....	.....	.....	.....	73	74.8	62.4	11.72	N.W.	13.7
Winter.....	.....	.....	.....	35.7	42.9	31.3	.....	.....	.....	.....	.....	.....	.....	.....	61	76.9	57.1	11.97	N.W.	15.4
Year.....	.....	.....	.....	53.5	56 0	50.2	.....	.....	.....	.....	.....	.....	.....	.....	90	76.7	248.7	47.67	N.W.	13.4

Table of Mean A. M., P. M. and Midnight Temperatures at Atlantic City and Sandy Hook, N. J., Baltimore, Md., Philadelphia, Pa., New York City, Jacksonville, Fla., and San Diego, Cal. Degrees Fahrenheit.

[From Annual Report Chief Signal Officer of the Army for 1887.]

STATIONS.	JANUARY.			FEBRUARY.			MARCH.			APRIL			MAY.			JUNE.		
	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.
Atlantic City	29.2	35.0	31.0	30.5	36.6	32.2	35.4	41.8	36.6	44.9	50.1	44.5	55.9	60.5	54 6	65.8	70.4	63.9
Sandy Hook	28.5	32.9	30.1	29.0	34.8	30.7	34.1	40.5	36.0	43.6	50.9	44.6	55.6	63.5	56.1	65.6	73.5	65.6
Baltimore, Md	31.0	37.5	33.6	32.7	41.2	35.8	37.9	46.6	41.1	48.7	59.1	51.5	60.2	70.9	61.9	70.2	79.9	70.7
Philadelphia, Pa	28.6	34.6	30.6	29.8	37.6	32.5	35.2	44.0	38.1	45.7	56.3	47.9	57.5	69.0	59.2	67.4	77.7	68.1
New York City	27.1	33.0	29.1	27.9	34.7	30.1	33.2	40.8	35.3	43.9	52.4	45.4	55.7	64.2	56.7	65.3	73.9	66.0
Jacksonville, Fla	50.2	61.9	53.6	52.5	64.8	56.2	57.2	69.5	60.4	65.1	75.6	65.6	73.3	80.9	71.8	79.3	85.0	77.1
San Diego, Cal	48.3	60.7	52.8	49.5	61.0	53.9	51.1	61.6	55.1	52.9	63.8	57.2	56.8	66.3	60.2	60.4	69.5	63.1

STATIONS.	JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.
Atlantic City	71.2	76.2	69.6	70.4	75.5	70.1	65.1	71.0	65.4	54.6	61.6	55.5	42.0	48.5	43.4	33.3	38.6	34.9
Sandy Hook	71.5	78.9	71.5	70.0	77.2	70.7	64.3	71.6	65.5	54.2	60.8	55.5	42 6	47.9	44.2	33.1	37.5	34.8
Baltimore, Md	74.7	84.5	75.2	71.2	81.3	72.9	63.8	74.5	66.1	53.3	61.0	56.0	42.2	49.8	44.2	33.5	40.4	36.2
Philadelphia, Pa	72.2	82.4	73.4	70.1	79.6	71.2	62.7	73.1	64.8	52.1	62.6	54.3	40.2	48.1	42.4	31.5	37.6	33.8
New York City	70.8	78.6	71.1	69.1	77.0	70.0	62.4	70.8	63.7	52.2	60.4	54.1	39.9	46.5	41.3	30.7	36.1	32.5
Jacksonville, Fla	80.9	87.3	79.1	79.2	85.7	77.7	75.0	82.7	75.9	66.1	75.8	68.0	56.5	68.1	59.7	50.2	62.5	54.1
San Diego, Cal	63.5	72.4	65.7	65.3	74.2	67.8	62.7	72.1	65.5	57.9	68.8	61.2	52.5	65.7	56.5	50.2	62.6	54.1

NOTE.—Observations prior to August 25th, 1872, were taken at 7:35 A. M., 4:35 and 11:35 P. M., Washington time; from August 25th, 1872, to November 1st, 1879, at 7:35 A. M., 4:35 and 11 P. M.; from November 1st, 1879, to December 31st, 1884, at 7 A. M., and 3 and 11 P. M., Washington time; and from January 1st, 1885, to December 31st, 1886, at 7 A. M., and 3 and 11 P. M., Seventy-fifth Meridian time.

CHRONOLOGICAL NOTES OF THE WEATHER.

REMARKABLE SEASONS; ICE IN RIVERS AND HARBORS; DROUGHTS, ETC., ETC., ETC.

[Abbreviations: W, Webster; H, Hazard; B, Blodgett; G, Gordon.]

The following brief notes of the weather have been gathered from S. Hazard's "Register of Pennsylvania," Vol. II., pp. 23–26 and 379–386, Philadelphia, 1828; Watson's "Annals of Philadelphia," 1844; Dr. Noah Webster's "A Brief History of Epidemics and Pestilential Diseases," Hartford, 1798; Blodgett's "Climatology of the United States," Philadelphia, 1857; and from meteorological data from various stations in New Jersey and Philadelphia since 1843.

1607-8.—Winter extremely cold. W.
1631.—De Vries arrived in the Delaware about the first of February; the season was so mild that his men could work in the open air in their shirt sleeves; (the earliest notice of weather on the Delaware.) G.
1638.—Summer very hot and dry. W.
1639.—No rain from April 26th to June 4th, O. S. W.
1641.—Summer wet and cold; very sickly on the Delaware river; settlement from New Haven broken up, and Swedes suffered greatly. W.
1641-2.—Chesapeake bay nearly frozen over. W.
1656.—Summer very hot. W.
1678.—December 10th, the Shield arrived at Burlington; river frozen next day. G.
1681.—December 11th, Delaware river frozen over; the Bristol Factor arrived at Chester with settlers for Pennsylvania, where they lay all winter. H.
1683-4.—Winter was excessively severe. W.
1697-8.—Winter very cold. Kalm.
1704.—Snow fell a yard deep. H.
1708-9.—A very severe winter. W.
1714.—February; flowers seen in the woods. H.
1717.—February 19th-24th, great snow—"greatest ever known," up to that time, in New England and on Long Island. W.
1719-20.—Winter very cold. W.
1720.—February 23d, Delaware clear of ice. H.
December 20th, Delaware full of ice; 27th, again clear. H.
1721.—December 19th, Delaware full of ice. H.
1722.—February 6th, Delaware open again to navigation. H.
1723.—January 6th, Delaware free from ice, and weather yet moderate. H.
1723-4.—December and January, river open. H.
1724.—December 15th, Delaware full of ice. H.
1725.—March 3d, snow two feet deep. H.
1725-6.—December 21st, Delaware full of ice until January 18th.
February 1st-15th, again blocked with ice. H.

1727.—February 14th, very cold weather. H.
Summer hot. W.

1728.—January 23d, severe weather for two weeks; booths set up on the Delaware; no clearance of vessels mentioned until March 5th. H.

1729.—December; Delaware open all the month. H.

1730.—January 20th, a deep snow, the like not known these several years; navigation closed. H.
December 21st, vessels forced back by ice; 29th, open. H.

1731.—February 9th, Delaware open again. H.

1731-2.—Delaware full of ice on December 14th; February 22d, navigation unobstructed. H.

1732-3.—December, Delaware open; January 18th, great snow at Lewes; March 8th, river open. H.

1734.—January 1st, Delaware continues open; very moderate weather. H.
December 21st, weather fine and open; Delaware free from ice. H.

1735.—January 16th, weather fine and open; Delaware free from ice. H.
December, weather fine and open; Delaware free from ice. H.

1736.—January 6th, Delaware fast and full of ice; February 5th, open. H.
December, Delaware open. H.

1737.—January 20th, weather very cold; February 3d, ice broke up in Schuylkill. H.

1738.—January and February, Delaware open. H.

1739.—January 25th, Delaware now open, having been fast since December 18th. H.

1739-40.—December, Delaware open; January 10th, closed; February 21st, arrivals; March 15th, ice broke up. H.

1740-41.—An exceptionally cold winter. Jefferson says that it was only less severe than that of 1779 80. B. Long Island Sound frozen over three leagues across. W. Delaware not navigable from December 19th until March 13th; January 8th, at Lewes, Del., 'tis all ice towards the sea as far as the eye can reach; snow three feet deep in back country. Much suffering among inhabitants and cattle. H.

1741-2.—Delaware open during December and January, and no mention of ice in February and March. H.

1742-3.—Another open winter. H.

1744.—January 3d, Delaware full of ice; January 19th, open. H.

1744-5.—No mention of ice; clearances and entries in all the winter months. H.

1745-6.—No ice mentioned; entries and clearances in December. H.

1746-7.—Delaware closed (no arrivals) from December 23d to February 24th. H.

1747-8.—December 15th, Delaware full of ice; January 12th, open; 26th, closed, and severe weather; February 2d, open; 9th, closed until March 1st. H.

1748-9.—Delaware open during December; closed in January; February 14th, arrivals. H.

1750.—January 22d, Delaware opened; February 6th, free of ice; May 30th, frost last week and snow in places. H.

1750-51.—Very severe winter. W. Delaware open January 22d. H.

1751-52.—Delaware full of ice, December 24th; clear again, February 18th. H.

1752.—A summer marked by intense heat in all parts of America; sickly. W.

1753.—January 2d, navigation on Delaware stopped; January 9th, open; 23d, clear. H.

1754.—January 15th, Delaware for some days clear of ice. H.

1754-5.—Winter unusually mild. Troops sailed from New York to Albany in January and February. W. January 14th, Delaware stopped; 21st, clear again. H.

1755-6.—Another mild winter. W. No mention of ice in the Delaware this winter, and entries and clearances every month. H.

1756-7.—No mention of ice in the Delaware, and entries and clearances throughout December and January. H.

1757-8.—Delaware open in December; February 2d, closed for few days. H.

1758-9.—December 28th, Delaware full of ice; January 11th, open; 25th, interrupted; February 1st, open. H.

1759-60.—December 28th, Delaware closed for a week; February 14th, open; March 20th, extraordinary snow storm, and greatest fall of snow since the settlement of the Province. H.

1760-61.—No entries or clearances at Philadelphia from January 15th to February 5th. H.

1761-2.—December 17th, Delaware interrupted by ice for several days; December 24th, quite stopped; January 21st, open. H.

1762.—Heat and drought exceeded what was ever known before; from June to September scarcely a drop of rain; forest trees scorched. W.

1762-3.—Snow fell November 8th, and it lay until March 20th. W. Delaware open in December; January 13th, stopped for some days. H.

1763-4.—Delaware open during December and January. H.

1764-5.—Navigation in the Delaware much obstructed by ice, from December 27th until February 28th; February 7th, an ox roasted whole on the ice at Philadelphia. H. March 28th, snow fell two to two and one-half feet deep on a level (last Saturday night and Sunday). H.

1765-6.—Delaware open until January 9th; February 6th, arrivals. H.

1766-7.—Delaware open until January 1st; a thaw, January 8th. H. At Brandywine, Del., 20° below zero. W.

1767-8.—Delaware closed for a day or two, December 24th; clear of ice, February 11th. H.

1768-9.—Navigation throughout December and January. H.

1769-70.—December 21st, navigation at a stand for several days; February 15th, river clear. H.

1770-1.—December, Delaware open; January, Delaware open; February 14th, river full of ice, stopping navigation; 28th, clear. H.

1771-2.—December 26th, Delaware full of ice; January, excessively cold month; February 20th, river open; March 16th, snow in many places two feet deep; much ice in river. H. April 2d, snow fell in several places six inches deep. H.

1772-3.—January 20th, Delaware full of ice; 21st, very cold; March 3d, navigation opened. H.

1773-4.—Delaware open in December; stopped January 12th, and February 14th, still fast. H.

1774-5.—December 30th, ice in river; open January 17th. H.

1778.—Summer very hot. W.

1779.—January 19th, Delaware closed; February, leaves of willows, blossoms of peach, and dandelion flowers were seen. H.

1779-80.—Coldest winter since 1740-41; from November 25th to middle of March cold was intense and almost uninterrupted; snow nearly four feet deep for three months; the sound was entirely covered with ice between Long Island and the main, and between New York and Staten Island. W. Troops crossed from New Jersey to Staten Island on the ice; the Delaware river was closed from the first of December to the fourteenth of March—the ice being two to three feet thick. B. During the month of January the mercury in Philadelphia did not rise to the freezing point, excepting one day. H.

1780.—May 19th, dark day, which reached as far south as New Jersey. W. Summer hot. W.

1780-81.—January 27th, winter thus far remarkably mild, so that the earth has scarcely been frozen half an inch deep. H.

1782.—January, Delaware frozen up since December 30th; closed to February 16th. H.

1783.—November 28th, navigation in Delaware stopped, and river frozen over until March 18th. B.

1784.—January, a thaw for two days; then a fall of 53° in a few hours. H. Summer extremely hot at Hartford. W.

1784-5.—December 26th, Delaware navigation at a stand; open January 3d; closed again 4th; open last of January; February 2d, closed. H.

1786.—January 26th, mild winter until middle of January; May, remarkable for the absence of the sun for two weeks, and a constantly damp or rainy weather. H.

1786-7.—Winter began early and was very severe. W.

1788-9.—A severe winter; the Delaware was closed from December 26th to March 10th; at Hartford, Conn., 28° below zero, February 2d. W.

1789-90.—Very open winter; February 7th to 17th, Delaware stopped with ice; March 10th, only considerable snow of the winter—remaining on the ground three days. H.

1790-91.—Delaware closed from December 18th to January 18th. H.

1791.—Excessively hot summer. W.

1791-2.—Delaware closed December 23d to end of month. H.

1792-3.—Delaware open during December; April weather in middle of January.

1793.—April 1st, blossoms universally—two weeks earlier than usual. H.

1793-4.—Very mild winter; lowest in New York, 13° above zero. W. January 13th, Delaware open. H.

1794-5.—Mild weather until middle of January; the Delaware closed from January 21st to 26th. H.

1795-6.—Winter most moderate for forty-five years; navigation interrupted on Delaware for one week in February by driving ice. H. The Hudson river closed by ice at Albany, January 23d, 1796.

1796-7.—Delaware closed, December 23d; Susquehanna closed, December 6th; January 10th, as cold weather as remembered in fifty years. H. At South and West extremely cold. W.

1797-8.—Winter long and cold; Hudson river closed in November. W. Delaware frozen over, December 1st; open again, February 5th. H.

1798–9.—A long and severe winter, with much snow; March 12th, deep snow. H.

1799.—Cold weather in spring; ice, April 20th; frost, June 6th. H.

1799–1800.—A remarkably open winter until January 6th; Delaware open again on 18th. H. Snow three feet deep in Georgia; snow and hail at St. Mary's river, in Florida. B.

1801–2.—February 22d, no obstructions this winter to impede navigation in Delaware, except floating ice. H.

1802–3.—Delaware frozen over December 19th. H.

1803.—May 7th, ice; on the 8th, a snow which broke down the poplars and other trees in leaf. H.

1804.—January 1st, vessels come and go on Delaware as in summer. H.
January 21st, river full of ice; March 5th, still frozen; clear on March 7th. H.

1804–5.—Delaware obstructed by ice, December 18th; February 28th, again navigable; a variable winter. H.

1805.—Summer; no rain after middle of June; all through July, heat 90°–96°. Watson.

1805–6.—An open winter; Hudson river free from ice, February 20th. H.

1806–7.—Navigation stopped December 18th until 20th. H.

1807–8.—Delaware open until January 11th. H.

1808–9.—Delaware open until January 5th; then much ice drifting at Cape May. H.

1809.—April 13th, snow; 26th, ice as thick as a dollar. H.
May 6th, ice; 13th, frost; cold May. H.
November 24th, snow one foot deep; sleighing. H.

1810.—January 10th, first ice of the season in the Delaware; river closed and opened several times; clear February 11th. H.
Hudson river open until January 19th. H.

1810–11.—Navigation on Delaware stopped December 18th; open early part of January; ice in February. H.

1811–12.—December 25th, Delaware full of ice; January 12th, river fast until February 8th. H.

1812.—May 4th, rain and snow; spring very backward. H. Memorable as a "cold summer." B. Very wet at harvest. W.

1812–13.—December 9th, Schuylkill fast; Delaware full of ice; January 11th, Delaware full of ice; February 26th, open. H.

1814.—January 9th, Delaware closed to navigation; February 2d, open and arrivals. H.

1814–15.—December 15th, floating ice in Delaware; March 5th, ice cleared. H.

1816.—Summer cold; both 1812 and 1816 were memorable as "cold summers" for all the northern United States; from May to September of 1812, each month was from 3°.6 to 7°.2 below the average; June and July, 1816, were 5° and 5°.8 below; in the Northern States snows and frosts occurred in every month of both summers; Indian corn did not ripen. B. Frosts at Philadelphia in June, July and August. B. & H.

1817.—January 19th, Delaware closed; March 9th, opened. H.

1817–18.—January 31st, Delaware closed; February 28th, opened. H. Hudson river closed for 108 days, until March 25th.

1818–19.—Winter severe in New England. B. Delaware was obstructed by ice in December; open in January for a time. H. Hudson river free from ice April 3d.

1819.—October 25th, snow in southeastern Pennsylvania. H.

1819-20.—December, Delaware open; February 4th, bay full of ice. H.

1820-21.—"This winter was one of four, during a century, in which the Hudson, between New York and Paulus Hook, was crossed on the ice." B. It closed November 13th, but opened again on 20th; closed December 1st; Delaware open during December; open February 14th. H.

1823.—January 22d, navigation in Delaware clear. H.

1824-5.—December, Delaware open; February 14th, clear of ice. H. Hudson river open until January 5th, 1825.

1824.—July 29th, 4½ inches of rain fell at Philadelphia; 11 inches at Germantown.

1825-6.—A cold winter; December 28th, ice in Delaware; January 31st, closed until February 8th. H.

1826-7.—Delaware open during December. H.

1827-8.—Navigation uninterrupted on the Delaware this winter; ice-houses unfilled. H. The Hudson at Albany closed for 43 days only; February 8th, free from ice.

1828-9.—Hudson river closed December 23d; free from ice April 1st.

1829-30.—Hudson river at Albany closed January 11th (1830); and free from ice again March 15th.

1830-1.—Winter very cold at Southwest; ice formed at New Orleans. B.

1835.—January and February both very cold; February 8th, thermometer fell below zero, nearly all over the country north of Savannah and Natchez; Long Island Sound was closed by ice; coldest winter since 1779-80. B.

1837.—Summer mean temperature, low. B.

1843.—March was coldest month of *winter* of 1842-3; snow 15 inches deep in Georgia. B. August, a remarkably heavy rainfall at Newark, 22.84 inches; at Lambertville, 15.26 inches; Hudson river free from ice at Albany April 13th, having closed November 26th, 1842.

1844.—January, cold; spring, warm; summer, below the mean temperature.

1845.—January, warm; minima, 8° to 18° above zero; minima for winter of 1844-5, 3° to 6° above zero.

1846.—Winter of 1845-6, colder than usual, but no very low temperatures; spring and summer cooler, and autumn warmer than average seasons.

1848.—Winter of 1847-8, warmer than average.

1849.—Below zero in January and also in February; autumn, warm.

1850.—Mean temperature for the year, high; winter of 1849-50, warm; minima, 3° to 8° above zero; autumn remarkable for its high mean temperature.

1851.—Winter of 1850-1 also warmer than average; no temperatures below zero recorded.

1852.—Winter of 1851-2, cold; mean temperatures of the months, 3° to 8° below the average; East river crossed on the ice January 30th, and for three days following; Susquehanna at Havre de Grace frozen over for seven weeks; cold and snows as far south as New Orleans and Jacksonville, Fla. B.

1853.—A warm year; range of temperature 2° to 93°; winter of 1852-3, one of the warmest on record, and very wet, the rainfall at Newark having been 15.85 inches.

1856.—One of the coldest years in our records; the first three months of this year very cold; a reproduction of 1779-80; March had minima of 0°.75 below zero to 4° above; in April the lowest temperature at Lambertville was only 17°; the mean temperatures for each of the spring months were below their averages since; Long Island Sound was closed to navigation from January 25th to February 27th; New York harbor was much obstructed by ice, and that of Philadelphia was closed until late in March; the Hudson river did not open until April 10th. The rainfall at Newark for the year only 34.07 inches.

1857.—Followed as another cold year; and the mean temperatures for the winter of 1856-7, of the following spring, summer and autumn were all low; all of the winter months were marked by low temperatures, and in January of this year the cold was intense; on the 24th, readings of 1° to 20° below zero were recorded, and the highest reached 35° to 47° only; the means for the month were 16°.22 to 22°.06; like 1856, the spring months were colder than the average; the summer was notable for its absence of extremely high temperatures, and its mean was low; altogether it was an exceptional year.

1858.—The cold seasons of 1857 were succeeded by the warm winter of 1857-8, although in February the thermometer, at several localities, fell to 6° to 8° below zero.

1859.—The year was exceptional in its cold summer; at Newark, the coldest in thirty-eight years, and 3°.2 below the average; the July mean was nearly 4° below the mean for the summers of the whole period; at Lambertville, the difference was 1°.4; the maximum, however, ranged from 91° to 100°; all the seasons were wet.

1860-2.—These years were noted for their rather cooler summers, and the absence of excessively high temperatures; February, 1861, was marked by depressions of 2° above zero to 7°.5 below zero.

1863.—The winter of 1862-3, like those of 1859-60 and 1860-1, was also characterized by its minimum occurring in February.

1865.—January was cold; the extremes were 11° below zero and 57° above.

1866.—This year was everywhere one of great range of temperature; the mean temperatures of the months and seasons were not far from the average; January 8th, the readings ranged between 9° and 20° below zero, at the several stations in New Jersey, and in the adjacent parts of Pennsylvania and New York; on the 17th of July, the maxima at these same places were 92° to 102°, making the range for the year 107° to 114°; in this respect the year is altogether exceptional.

1867.—Unlike the last, 1867 was more even in temperature, the range being from 0°.5 to 88° at Newark; the spring and summer were cooler and the autumn a little warmer than the means for 38 years; the year was wet, and the summer rainfall at Newark amounted to 24.11 inches; at Philadelphia, Pa., to 30.82 inches, and that for the year to 62.94 inches—a great excess.

1868.—The winter of 1867-8 was cold; at Newark it was the coldest of the thirty-eight-year period; and on forty-seven days the thermometer did not rise above freezing (32°). In February, records of 3° to 10° below

zero were made at several stations, and the mean for that month ranged from 5° to 10° below the average; it was the coldest February observed at Newark; the total depth of snow was six feet three inches, the deepest in the series; March and April were cold, and freezing weather continued to the middle of April; the Hudson river was not open to navigation at Albany until April 5th; the yearly mean was also lower than usual.

1869.—The winter of 1868-9 had no extremely cold weather, and the lowest temperatures were 3° to 8° *above zero;* the Hudson river closed early—December 5th.

1870.—Again in 1869–70 the winter was warm and remarkable for its low range of temperature; the lowest readings did not reach zero, and the average among the several stations was between 5° and 13° above; the summer was above the average temperature.

1871.—The extremes of the winter of 1870-1 were quite low in all the months, although the average was high; the spring was warmer than usual, and readings of 82° and upwards occurred in April; a depression of 1° to 6° below zero took place in December (21st); the Hudson river closed at Albany very early—November 29th.

1872.—The spring was colder and the summer warmer than the means for those seasons show; March, at Newark, was the coldest in the 38 years of observations.

1873.—The winter months (1872-3) all were remarkable for low temperatures; the minima of December, 1872, were zero to 7° above; those of January, 1873, were between 0°.5 and 22° below zero; the depression over the northern half of the State was severe (12° to 22° *below zero);* in February, also, the observations showed readings for zero to 6° below zero; the Newark record shows that in 43 days the thermometer did not rise above freezing; the Hudson river was closed from December 9th to April 16th.

1874.—The year was notable for its lesser range of temperatures than ordinary.

1875.—A cold year; its mean temperature at Newark, only 48°.2, or nearly 3° below the average, and the coldest in the series; the winter of 1874–5, the following spring and autumn were all cold; the spring and autumn were the coldest observed at Newark, in that all the months were either below or little above the average mean, and the monthly ranges were generally small; the highest temperature in January, in the northern part of the State, was 41°; the lowest 8° below zero; the summer was very wet.

1876.—The winter of 1875-6 was comparatively mild; the summer was remarkable for its long-continued heat and its severe drought; the records show maxima of 90° and upwards for each of the summer months at all the stations; the mean monthly temperatures range from 70° to 80° at very nearly all of them; the rainfall at Newark was little more than half the usual depth.

1877.—The winter of 1876-7 was cold; December, at Newark, had a mean temperature of 23°.8, the lowest in the 44 years' period; the month corresponded to our January, ordinarily; the Hudson river closed at Albany on the 2d of December, and did not open until March 30th; the summer of 1877 was the warmest in the Newark series; the

autumn, also, was warmer than usual; no readings below freezing (32°) were recorded in October, and the length of the seasons between frosts was much greater than common; the Moorestown record shows 203 days, from April 13th to November 4th; December of this year is noted for the entire absence of snow in all the central part of the State.

1878.—The winter of 1877-8 had a high mean temperature; the snowfall at Newark was but 1 foot 2 inches in depth; the Hudson river did not close until December 31st; the spring was unusually warm, and the month of April was the warmest in the Newark series, its minimum being 40° and its mean temperature 55°.5, or within 5° of the average May temperature; the summer, also, was warmer than the average. The yearly mean temperature at Newark was 53°.6, the highest in 44 years.

1879.—The winter of 1878-9 ranked among the colder winters; the Hudson was closed between December 20th and April 4th—100 days; the autumn was remarkably dry, the rainfall at New Brunswick amounting to 3.58 inches only.

1880.—An exceptional year in several ways. The winter of 1879-80 was remarkably warm—above the average at Newark; the average for January being 37°.6, highest in the 44 years' record, and 18°.3 above that of January, 1857; May remarkably warm, the average at Newark, 68°.4, highest in the record, and having reached a maximum of 96°; December was noted for its low temperatures, from zero downwards, all over the State, north of Cape May. The year was dry, and the drought was such that wells and springs were lower than for 38 years past.

1881.—The winter of 1880-1 was a cold one, and the snowfall was deep. *For 153 days, from November 22d, 1880, to April 23d, 1881, inclusive, the average temperature at New Brunswick was 29°.3, or the average for the three winter months* (*a winter of five months*). At Freehold, 75 inches of snow. Hudson river closed at Albany, November 25th, and opened March 21st, 1881. The summer and autumn were warm, and marked by a most severe drought. [See page 375.] At Newark and New Brunswick the months of August, September and October were marked by uncommonly high temperatures. The 7th of September had an average temperature of 89°.7 at Newark; and the maximum was 100°.5—"*above that of any day in any month in any year during the whole period.*"

1882.—The winter of 1881-2 was one of the warmest on record, the average temperature at Newark being 33°.7; the Hudson river, at Albany, was open until January 2d, 1882; the summer was warm and dry; the autumn was exceptionally wet, and September was memorable for its heavy rainfall, amounting to 17.6 inches at Newark, 15.5 inches at New Brunswick, 14.9 inches at Atlantic City, and 25.9 inches at Paterson.

1883.—The winter of 1882-3 was longer and colder than the average; the summer was marked by an absence of excessively hot weather.

1884.—An average year in temperature and rainfall. September was the driest on record, the rainfall varying from two to four-tenths of an inch only. Warmest April on the Newark record.

1885.—Another year of comparatively more even temperature, excepting April, whose maximum was 86° at Newark; Hudson river at Albany closed to navigation until April 7th.

1886.—No great extremes either in temperature or rainfall marked the year; the minimum for October, at Newark, was 36°, the highest on the record at that place.

1887.—The average winter temperature for the State was 32°.6; the range from 102° to —4°.5; the rainfall varied from 37.9 inches, at Atlantic City, to 53.3 inches at Somerville.* The year, at Newark, had the following extremes: minimum of 16° for February, maximum of 50° in March, minimum of 46° in May, and of 66° in July.

1888.—March 12th and 13th were noted for the occurrence of a furious storm (blizzard) of wind, snow and extreme cold; the snow drifted into hard-packed banks 5 to 15 feet high; the thermometer was but little above zero, and all railroad and telegraphic communication was stopped for several days. It was an unexampled storm in this generation.

These notes show the great variation in temperature and rainfall from year to year and for the corresponding seasons of the years. Extending as they do, over two and a half centuries, this range of extremes is greater than that which is shown by our meteorological records, whose lengths are limited to periods of twenty to thirty, and in three cases only, to more than forty years. They show further how incomplete measures of these extreme phenomena our records are, although the averages may be approximately attained in the twenty to fifty-year periods or series. Of course many of the earlier notes are very fragmentary, and give results of great heat and severe cold instead of any proper meteorological measurements of their intensity. However, the winters of 1740–1, of 1779–80, of 1820–1, and of 1856; the snows and ice in May, 1808; the severe snow storm and blockaded roads and railways in March, 1888; the frosts every month in the summer of 1812, and again in that of 1816, are quite as decisive and emphatic as any thermometric records would be, and they indicate to us the possibilities in weather phenomena. In short, they may occur again, and the experiences of the past be repeated in our time. They constitute a striking illustration of the uncertainties of the weather, and in them we discover no law which would enable us to predict the seasons in advance, or solve the problem of meteorology.

* From Mr. E. W. McGann's Ann. Sum. for 1887.

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation.

[From the reports of the Regents of the University, and other sources.]

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1646		November 25th	
1675-6	February 26th		
1786	March 23d		
1789		February 3d, (1790)	
1790	March 27th	December 8th	256
1791	March 17th	December 8th	266
1792		December 12th	
1793	March 6th	December 26th	295
1794	March 17th	January 12th, (1795)	301
1795		January 23d, (1796)	
1796		November 28th	
1797		November 26th	
1798		November 23d	
1799		January 6th, (1800)	
1800		January 3d, (1801)	
1801	February 28th	February 3d, (1802)	340
1802		December 16th	
1803		January 12th, (1804)	
1804	April 6th	December 13th	251
1805		January 9th, (1806)	
1806	February 20th	December 11th	294
1807	April 8th	January 4th, (1808)	271
1808	March 10th	December 9th	274
1809		January 19th, (1810)	
1810		December 14th	
1811		December 20th	
1812		December 21st	
1813	March 12th	December 22d	285

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation—Continued.

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1814	.....	December 10th	.....
1815	.....	December 2d	.....
1816	.....	December 16th	.....
1817	.....	December 7th	.....
1818	March 25th	December 14th	264
1819	April 3d	December 13th	254
1820	March 25th	November 13th	233
1821	March 15th	December 13th	273
1822	March 15th	December 24th	284
1823	March 24th	December 16th	267
1824	March 3d	January 5th, (1825)	308
1825	March 6th	December 13th	282
1826	February 26th	December 24th	301
1827	March 20th	December 25th	280
1828	February 8th	December 23d	319
1829	April 1st	January 11th, (1830)	285
1830	March 15th	December 23d	283
1831	March 15th	December 5th	265
1832	March 25th	December 21st	271
1833	March 21st	December 13th	267
1834	February 21st	December 15th	297
1835	March 25th	November 30th	250
1836	April 4th	December 7th	247
1837	March 28th	December 13th	260
1838	March 19th	November 25th	251
1839	March 21st	December 18th	272
1840	February 21st	December 5th	288
1841	March 24th	December 19th	270
1842	February 4th	November 29th	298

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation—Continued.

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1843	April 13th	December 9th	240
1844	March 14th	December 11th	272
1845	February 24th	December 4th	283
1846	March 15th	December 15th	275
1847	April 6th.	December 24th	262
1848	March 22d	December 27th	280
1849	March 19th	December 25th	281
1850	March 9th	December 17th	283
1851	February 25th	December 13th	291
1852	March 28th	December 22d	269
1853	March 21st	December 21st	275
1854	March 17th	December 8th	266
1855	March 20th.	December 20th.	275
1856	April 10th	December 16th	250
1857	February 27th	December 27th	303
1858	March 20th	December 18th	273
1859	March 13th.	December 10th	272
1860	March 6th	December 14th	283
1861	March 5th	December 23d	293
1862	April 4th	December 19th	259
1863	April 3d	December 11th	252
1864	March 11th	December 12th	276
1865	March 22d	December 16th	269
1866	March 20th	December 15th	270
1867	March 26th.	December 8th	257
1868	March 24th	December 5th	256
1869	April 5th	December 9th	248
1870	March 31st	December 17th	261
1871	March 12th	November 29th	262

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation—Continued.

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1872	April 7th.	December 9th	246
1873	April 16th	November 22d	220
1874	March 19th.	December 12th	268
1875	April 13th	November 29th	230
1876	April 1st	December 2d	245
1877	March 30th	December 31st	276
1878	March 14th.	December 20th.	281
1879	April 4th	December 20th	260
1880	March 5th	November 25th	265
1881	March 21st	January 2d, (1882)	287
1882	March 8th	December 4th	272
1883	March 29th	December 15th	261
1884	March 25th.	December 19th.	269
1885	April 7th	December 13th.	250
1886	March 30th.	December 3d.	248
1887	April 9th	December 20th.	255
1888	April 5th		

Dates of Closing of Navigation on the Delaware River since 1872.

YEAR.	CLOSING.	YEAR.	CLOSING.
1872	December 1st.	1880	December 11th.
1873	January 15th, 1874.	1881	January 4th, 1882.
1874	December 30th.	1882	December 20th.
1875	December 19th.	1883	December 25th.
1876	December 10th.	1884	December 20th.
1877	January 3d, 1878.	1885	January 10th, 1886.
1878	December 23d.	1886	December 6th.
1879	December 31st.	1887	December 29th.

The above dates were kindly furnished by Capt. H. E. Melville, Superintendent of the Philadelphia city ice boats, who states in his letter of transmittal "that the Delaware river is not closed by ice, as the ice boats are maintained by the city of Philadelphia to keep it open. The dates are those when the river was sufficiently obstructed by ice to warrant the city ice boats being placed in commission, since the year 1872. They are generally in commission until the middle of February, with a few exceptional seasons."

Dates of Opening and Closing of Navigation on Delaware and Raritan Canal, from 1834 to 1888.

YEAR.	OPENING.	CLOSING.	NO. OF DAYS OPEN.
1834	August 20th	December 15th	117
1835	March 16th		
1836	April 18th		
1837	April 20th		
1838	April 10th		
1839	March 15th		
1841	April 5th		
1842	March 28th		
1843	May 1st		
1845	March 18th		
1846	April 15th		
1847	March 5th		
1848	March 20th	December 25th	280
1849	March 15th	December 20th	280
1850	March 11th	December 28th	292
1851	March 14th	December 20th	281
1852	March 15th	December 24th	284
1853	April 4th		
1854	March 1st		
1855	February 15th	December 25th	313
1856	March 28th	December 25th	272
1857	March 12th	January 10th (1858)	304
1858		December 25th	
1859	March 15th	December 24th	284
1860	March 20th	December 24th	279
1861	March 21st	December 20th	274
1862	March 20th	December 20th	275
1863	March 10th	December 25th	290
1864	March 8th	December 17th	284

Dates of Opening and Closing of Navigation on Delaware and Raritan Canal, from 1834 to 1888—Continued.

YEAR.	OPENING.	CLOSING.	NO. OF DAYS OPEN.
1865	March 14th	December 23d	284
1866	March 15th	December 18th	278
1867	March 18th	December 20th	277
1868	March 23d.	December 19th	271
1869	March 10th	December 25th	290
1870	March 10th	December 24th	289
1871	March 13th	December 15th	277
1872	March 15th	December 15th	275
1873	March 17th	December 20th	278
1874	March 16th	December 19th	278
1875	March 22d.	December 24th	277
1876	March 20th	December 20th	275
1877	March 19th	December 22d	278
1878	March 18th	December 21st	278
1879	March 17th	December 20th	278
1880	March 15th	December 18th	278
1881	March 21st	December 20th	274
1882	March 6th	December 20th	289
1883	March 12th.	December 20th	288
1884	March 10th	December 20th	285
1885	March 16th	December 19th	278
1886	March 15th	December 20th	280
1887	March 14th	December 19th	280
1888	March 12th		

Dates of Opening and Closing of Navigation on Morris Canal, from 1869 to 1887.

YEAR.	OPENING.	CLOSING.	NO. OF DAYS OPEN.
1869	March 25th	December 6th	256
1870	March 28th	December 6th	253
1871	April 1st	December 5th	248
1872	April 9th	December 4th	239
1873	April 9th	November 27th	232
1874	March 23d	November 27th	249
1875	April 9th	December 7th	242
1876	April 7th	December 1st	238
1877	March 26th	December 5th	254
1878	March 20th	December 6th	261
1879	March 29th	December 5th	251
1880	March 23d	November 27th	249
1881	March 28th	December 10th	257
1882	March 29th	November 29th	245
1883	April 2d	December 8th	250
1884	March 29th	December 8th	254
1885	April 13th	December 11th	242
1886	March 29th	December 4th	250
1887	April 1st	December 2d	245